April 1945

Surveying and Mapping

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To Municipal Engineers
H. R. SAUNDERS

Engineer's Place in Civilization
LOUIS H. BERGER

Programming Surveys and Mapping
LIEUT. COL. A. J. SWEET

Key to a Better Understanding of Maps
CAPTAIN W. H. GILL

Latitude and Longitude by Altitude Observations
CAPTAIN F. B. T. SIEMS

Surveying and Mapping at Aviation Conference
LIEUT. COMDR. P. A. SMITH

The Use of Balloons and Radios in Mapping
WM. T. RYALL

Topographic Mapping with the Multiplex
MILTON J. HARDEN

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Contents

EDITORIAL—TO MUNICIPAL ENGINEERS 2
Howard R. Saunders

THE FIFTH ANNUAL MEETING 2, 64

THE ENGINEER'S PLACE IN CIVILIZATION 3
Louis H. Berger

PROGRAMMING SURVEYS AND MAPPING IN URBAN AND METROPOLITAN AREAS 7
Lieut. Col. Arthur J. Sweet

LATITUDE AND LONGITUDE BY SERIES OF ALTITUDE OBSERVATIONS 12
Captain F. B. T. Siems

KEY TO A BETTER UNDERSTANDING OF MAPS 16
Captain William H. Gill

SURVEYING AND MAPPING AT CIVIL AVIATION CONFERENCE 22
Lieut. Comdr. Paul A. Smith

THE LAND SURVEYOR AND THE GEOLOGIST 25
C. D. Brown and F. D. Shepherd

U. S. GEOLOGICAL SURVEY 28

THE USE OF BALLOONS AND RADIOS IN MAPPING 34
William T. Ryall

TOPOGRAPHIC MAPPING WITH THE MULTIPLEX AERO PROJECTOR 39
Milton J. Harden

SURVEYING AND MAPPING IN THE JUNIOR COLLEGE 47
Charles E. Herr

SURVEYING AND MAPPING NEWS 49

PROPERTY SURVEYS DIVISION 57

COMMENT AND DISCUSSION 59

CONGRESS NEWS 63
Announcing a Prize Competition 63

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Editorial:

To Municipal Engineers

WE READ and hear on every hand about the necessity of planning now for postwar work. Without any doubt there will be a period of readjustment which will require a certain amount of self-made work to help cushion the sudden let-down in war production.

The urgent need for adequate maps, one of the basic requirements for all engineering projects, will once more be emphasized. Now is the time to make an inventory of what is available, what will be required, and to make plans for filling the missing gaps.

One of the most frequently heard criticisms of the civil engineering profession is its indifference toward the importance of having adequate base maps. This indifference is illustrated by the lack of standardization in nomenclature and symbols for all municipal maps; the too often found neglect in planned co-ordination of size and scale between various sets of maps in a municipality; and a heterogeneous, rather than a simplified, system of indexing all data pertaining to the map and survey records.

Those who have become cognizant of these facts will readily appreciate the value of having an organization such as the American Congress on Surveying and Mapping, together with its fast improving Journal, to bring together all parties interested in the advancement of this work.

Now is the opportunity, as well as the civic duty, for every municipal engineering office in the country to have at least one representative member in the CONGRESS to participate in this constructive work; to help in planning this field of our postwar expenditures so that the result will be productive work, rather than just a job for the ex-soldier.

HOWARD R. SAUNDERS,
Vice President, Region 8.

Fifth Annual Meeting

WASHINGTON, D. C.—JUNE 23, 1945

—PANEL DISCUSSION—

"Co-operation Among the Technical Organizations"

The Engineer's Place in Civilization

By LOUIS H. BERGER*

WHEN a man's life effort and interest are centered in one pursuit, it is altogether too easy, when discussing it, to wax so enthusiastic as to become a bore to one's listeners or readers. Therefore, at the outset of this brief article concerning precision engineering instruments, their design, fabrication and use, the writer will endeavor to keep in mind the probable limits of interest which the reader may possess about the subject.

Such exceptional strides have been made during the war years in the development and application of precision instruments that the engineering profession can admit, however reluctantly from the standpoint of humaneness, that some good does come out of such a holocaust as World War II, and that lessons learned in the bloody crucible of conflict can be advantageously applied to future engineering problems of what we all hope will soon be the piping times of peace.

And, many of the engineering projects made necessary by the war will fortunately be useful in peacetime. The same can be said of the tools and instruments with which the engineers have been working. In fact, as all engineers know, new developments for the advancement—rather than the destruction—of civilization are now being planned to rise from the very ashes of the war.

Scientists Prefer Constructive Projects

The maker of surveying and other engineering instruments of precision would far rather know that his products are assisting in civic improvements, in great communication projects, in mining for minerals needed for a civilization progressing under the covenants of peace, than that they are used for the miscalled arts of war. Yet it is comforting to know that these same instruments, adapted and improved under the stress of war emergencies, may have helped speed the culmination of a war that is being waged to save civilization.

Engineering Ushered in a Progressive Civilization

The term civilization is comparative. If primitive man had thought about it in terms of ethical progress—which doubtless he did not—he would have realized what a tremendous step he had made forward when he discovered the first uses of a wheel. To him it was a strange, round, rather awesome object, as he watched it revolve, saw it used to convey

* President, C. L. Berger & Sons, Inc.

and later lift objects; and his groping mind began to envision the tremendous scope of its possible adaptation. It was that primitive wheel that was the forerunner of modern engineering. In the creation and application of the wheel, it may be said that engineering was born on this earth. Perhaps it was a millenium later before some groping student in what still later became the realm of mathematics, attempted to divide the circle into segments, or degrees. And from that division of the circle, the rudiments of simple geometry began to issue from man's thinking.

The principle of the wheel and the mathematical use of the circle are fundamental in even the simplest of surveying instruments. What a far cry it is from the rough, primitive wheel of antediluvian man to the utterly precise, delicately tooled transit, theodolite, or collimator of today! Fortunately for humanity, all the wars in history have failed to extinguish knowledge; nor have they discouraged mankind from continuing its ceaseless search after truth, which science always reveals. Thus in the days of peace ahead, the recent developments in precision engineering instruments will find new application in branches of science yet untouched.

It is not true, as some writers would have us believe, that there are no more frontiers. The fact that the era of pioneer settlements in America has gone does not imply that we have pre-empted the paths of progress. Science is forever on countless new frontiers of discovery. As science advances in each new field of exploration, the trained tool-maker, the designer, the engineer, the laboratory worker—all are frontiersmen, clearing paths for achievements to make life itself more livable. Speaking of the myriad jobs that science is concerned with, the New York Times recently said in an editorial:

> Any good newspaperman can dream through five columns of airplanes that will take us for week-end outings in the Himalayas, of cooked food shot through pneumatic tubes from some central kitchen into the home, of cities roofed over and completely air-conditioned, of plastics that take the place of wood and metal, of synthetic chemicals that nature forgot to make, and of a thousand ways of keeping house or running factories with electric machines still to be invented. These are but the natural evolution of the contrivances we have. They call for some social adjustment, but they no longer make us gasp with wonder. The war alone has accelerated the pace of discovery and invention, so that the dreams of yesterday are already realities.
>
> *It is the effect of science on world thinking that is important.* (Author's italics.) With civilized mankind everywhere riding in automobiles which are very much alike, bathing in tubs that are alike, reading by electric lamps that are alike, cooking with gas which is everywhere the same, listening to a single radio program that comes from London or New York, and rocking with laughter at the same Hollywood film, it is plain enough that technology is standardizing the world, and that it is harder than ever to be "different."

There may be drawbacks to this uniformity, but on the whole the world is tending more and more to think as a unit. It is the outlook that is important, and it is because sciences shape the outlook that it is a powerful aid in welding peoples together.

Scientists have realized for generations that their outlook has been identical, whether the scientist is in America, Australia, the British Isles, or China. The lessons learned by engineers in building the great Alcan Highway to Alaska are applied to similar jobs in South Africa or the steppes of Siberia. The same instruments, the same mathematics, are employed. Aviation and radio have shrunk the size of this vast world. Engineering creates a common fund of progress-building knowledge. Instrumentation preserves the accuracy of engineering, so that railroads or tunnels begun at two points far distant from each other will meet exactly to the fraction of a millimeter. Precision instruments for measuring and locating permit the manufacture of different parts of motors, machines and other precise units, in widely separated parts of the globe, so that when assembled these parts are utterly accurate in their relation to one another.

New Frontiers Are in the Making

Some critics are of the opinion that there is too much talk about industrial expansion after the war, and that the implied promises as to new developments in design, materials and fabrication are exaggerations, if not downright pipe dreams. They cite opposite prophecies from deeply pessimistic observers, to the effect that the strained economic situation of the postwar era will prohibit all new development. Indications are that these gloomy few are incorrect in their jaundiced outlook. Even if the new developments may be a little slow in gathering momentum, this will not prevent new thinking, new planning, new tests and researches to discover and prove the wider uses for constructive tools and instruments that can speed engineering when the correct moment arrives for their application. You may be sure that the makers of precision engineering instruments will not be idle; they are finders of frontiers.

Engineers are born frontiersmen, literally and figuratively speaking. Engineers cannot get into ruts, because their science depends upon progress; otherwise we would not be constructing steel bridges today, nor vast concrete dams. The instrument maker depends as much on the vision and foresight of the engineer as does the surveyor on his transit and theodolite. Engineer and instrument maker are interdependent for mutual improvement in their respective and correlated branches of science. If new design, new tooling, new fabrication are needed to improve an instrument needed for a specific precise function in engineering, then these must and will be achieved.

If economics were only as precise a science as that of engineering, we could look forward to a war-free—almost entirely trouble-free—world in the future. But, unfortunately enough, economics seems to get tangled up with that erratic and fluid thing known as human nature, so that no set rules can be found nor applied. But it is nonetheless the hope of the engineer, be he a bridge builder, a miner, or an instrument maker, that the pure truths of science can develop a better world, a happier, saner civilization. The engineering profession is always striving to make life fuller, easier, more enjoyable, more worthwhile.

Monuments have been erected memorializing some of the brilliant and extraordinary feats of the engineer, many of which seemed almost insurmountable at the time and were accomplished only under the severest, and oftentimes untold, hardships mankind has had to endure. But these monuments pale in comparison with the works which these intrepid engineers have left to posterity. They have memorialized themselves to humanity far better by the completed projects they have left behind—enduring examples to inspire and benefit mankind throughout the ages.

* * *

Historic Scientific Instruments and Books

A COLLECTION of historic scientific instruments and books has been presented to the University of Cambridge by R. S. Whipple. The exhibit is described in *The Times* (London) as follows:

The collection is notable for its range and variety as well as its representative examples of fine craftsmanship from those centers in all countries where science flourished for nearly four centuries. Among astronomical instruments shown are astrolabes, nocturnals, and a remarkable collection of sundials of various shapes, sizes, and materials by English and Continental makers from the sixteenth century onwards. Refracting and reflecting telescopes are well represented, and a feature of the exhibition is a Newtonian reflecting telescope in perfect condition made and used by Sir William Herschel, with 8-inch speculum mirror of 10-foot focal length, together with a finder telescope and a complete set of eye-pieces. The instrument was presented to the present collection for Cambridge by the late Howard Marryat.

The collection of microscopes contains examples of each important type from the times of Robert Hooke and Leeuwenhoek to the end of the last century and is a remarkable exhibit. Among other exhibits are numerous surveying, mathematical, and physical instruments; scales and weights; and a case of miscellaneous optical instruments containing an ingenious walking-stick and umbrella complete with telescope, spy-glass, compass, microscope, thermometer, and sundial, *c.* 1860. Among the 1,500 volumes of books are first editions of the works of Gilbert, Bacon, Galileo, Boyle, Hooke, Newton, Darwin, and other scientific classics.

Programming Surveys and Mapping in Urban and Metropolitan Areas*

By LIEUT. COL. ARTHUR J. SWEET†

THIS meeting of the Congress has a particular appeal to me because it has as its keynote surveying and mapping problems *after the war*. I am sure we all take a great deal of pleasure in thinking about getting back to a normal way of living, of being able to concentrate on the problems of building for a better future, of being able to think in terms of what needs to be done and how best to go about doing it, and, most important, of being able to put those ideas and plans into operation. Some, perhaps, are worried about that future day, worried about returning to normal life, but without a job, and worried about how we can pay for the cost of the war and at the same time build for the future. Personally—if I may be permitted to offer an opinion—I envision a long period of the greatest prosperity we have ever had, a period of manufacturing all the things we have had to do without, of developing for peacetime use the many inventions that will come out of the war, and of building the many public improvements that this prosperity will make necessary. These public improvements will require planning, careful planning, and by careful planning is meant economical planning based on accurate maps.

During the depression and following the depression, depending upon when one considers the depression to have ended, we were able with the aid of the Federal Government to make a great number of public improvements. In a large percentage of cases the planning of these improvements was pretty much haphazard. Most of the cities not only did not have a carefully prepared plan upon which to base their public improvements, but, also, didn't have any accurate maps that could be used to draw a plan. There wasn't time to make the necessary maps and plans. The main thing was to put people to work, and, as a result, a great deal of effort and money was put into public improvements which will some day either be scrapped entirely or altered at great expense. That type of public improvement is wasteful and only serves to make it more difficult to do the sort of thing that should have been done in the first place. A small number of cities had the maps and plans required, and some took the time to secure good topographic maps, to prepare sound over-all plans, and to make each project fit in properly with the plan for their future

* Presented at Annual Meeting, Washington, D. C., June 3, 1944.

† Executive Officer, Topographic Branch, Military Intelligence Service, Corps of Engineers, U. S. Army.

development. Those cities will be in an enviable position after the war. It is hoped that the other cities, which had no accurate survey data on which to base their plans, will not make the mistake a second time.

Immediately after the war will be an opportune time to put into operation the sort of survey that will provide the information needed for planning purposes. Such a survey, however, should also supply the foundation and control for the routine and special engineering surveys required in any municipality. It should provide accurately established permanent monuments for checking property surveys, for establishing block distances, and for tying-in of the cross section surveys for new highways and street widenings. It should supply topographic maps, accurately drawn and large enough in scale to permit planning the exact locations of public improvements, and should also provide maps of underground structures so that the final working drawings will take cognizance of all the problems involved on each project.

Type of Survey Required

The accepted type of Survey designed to provide the basic data figured by cities and metropolitan areas consists of the following: Triangulation, Traverse, Levels, Topographic mapping, and Underground survey.

Triangulation.—The triangulation network provides the basic horizontal control for other operations of the Survey. It should be executed with a great deal of precision so that the positions it establishes will never be subject to question as to their accuracy. The time and effort expended in making a highly accurate and completely usable network of triangulation will prove to be of little consequence compared with the great saving of time and money that will result in later years.

The locations of stations of the network should be carefully planned by painstaking field reconnaissance and should be so spaced that they will provide control points conveniently located where they will be needed most. Reconnaissance work for triangulation of a city or metropolitan area requires a lot of patience and can be quite exasperating. The time spent, however, in doing a thorough job of reconnaissance will prove invaluable when the final results are known. In heavily built-up areas the stations are distributed at the rate of one station to about 2 square miles. In outlying areas this is generally increased to about 4 square miles. Careful thought should be given to the locations and length of base lines. One to 4 miles in length is the generally accepted practice. The measuring of base lines and observing of angles should make use of the most precise equipment available and follow established procedure. To properly serve as basic horizontal control for other phases of the Survey, it should be executed with an accuracy of at least 1: 100,000.

Traverse.—The traverse network should be designed to make full use of the triangulation stations to maintain accuracy. It should be planned to supply not only the control for the topographic mapping and underground survey, but also the starting and tying-in stations for any lines that are run whether they be for cross sectioning, establishing property markers, checking block dimensions, or laying a sewer. The traverse is generally divided into three classes; namely, first-, second-, and third-order. The first-order lines are those run directly between triangulation stations or from triangulation stations to junction points. This class of traverse should be held to an accuracy of about 1:35,000. That accuracy can be maintained using the standard procedure for precise measuring of angles and taping with tape supports, provided the lines are located along fairly level terrain and the courses are kept close to 1,000 feet. Second-order traverse supplements the first-order lines to provide traverse lines at intervals of about three-fourths of a mile. The field procedure is generally the same as that for first-order traverse, but courses are apt to be shorter and grades much greater, and the same accuracy can hardly be expected. An accuracy of 1:20,000 or 1:15,000 will generally suffice for second-order traverse. The third-order traverse is generally quite temporary in nature and serves as additional control for the topographic and underground mapping. This class of traverse should be held to an accuracy of 1:5,000.

Levels.—The leveling phase of the survey is one that can be used to decided advantage in any city or metropolitan area. Probably more headaches develop in the design and construction of highways and bridges from the lack of accurate levels than from any other source. A carefully executed network of precise levels will come close to paying its way on just one important construction project. Like the traverse stations, the bench marks of the level network should be used as starting and tying-in stations for all types of municipal surveying. Levels are generally divided into two classes—first- and second-order. Both classes of levels follow the same general courses as the precise traverse and should use the same permanent monuments as bench marks. The first-order levels are double-run lines and are spaced at about two-mile intervals. The second-order levels are single-run and spaced at intervals of about three-fourths of a mile.

Topographic mapping.—Topographic maps can serve a multitude of uses in any city or metropolitan area if accurately drawn and at proper scale. Terrain doesn't change materially through the years, and a topographic map, if well made, can serve for many years as the basis for the planning of all public improvements. The acceptable scale and one found to be most practicable is 1 inch to 200 feet. This scale map will serve for

over-all planning as well as planning the definite locations for all types of public improvements. If the map is well made, it can be enlarged to a scale of 1 inch to 100 feet and used for detailed planning purposes. The Cleveland Regional Geodetic Survey is making maps at a scale of 1 inch equals 200 feet, and the State Highway Department of Ohio uses these same maps enlarged to a scale of 1 inch to 100 feet for its location plans for the freeways being constructed in the Cleveland area.

Most of the large-scale topographic mapping in the past has been by the planetable method, but it is quite obvious that camera equipment has been so improved during the war that in the future this large-scale mapping will be accomplished by the use of aerial photography. It will probably mean a great saving in the cost of mapping besides permitting large areas to be mapped in a much shorter period of time.

Underground survey.—The underground survey is a natural adjunct to any city or metropolitan survey. Most public utilities have the information concerning the locations of underground structures, and this information, along with the facts concerning the sewer and water lines, when put together in map form supplies a wealth of information essential to any planning of public improvements.

Method of Operation

The means by which a program of urban and metropolitan surveys may be put into operation is generally the big stumbling block. No one public agency, such as the office of a municipal engineer or a city planning commission, is normally in a position to supply the personnel or absorb in its budget the cost of executing a survey of this type, nor is it desirable to have one agency assume the responsibility. If one agency bears the cost, it is only natural that the specifications for the work will be based on the use which that particular agency will make of the finished product. A county sanitary engineer, for instance, would probably find topographic maps at a scale of 1 inch to 400 feet entirely satisfactory for his use, whereas a city planning agency would find that scale entirely too small for anything more than general planning. Likewise the planning agency is naturally not going to be greatly concerned about the need for precise traverse and level control on which to base municipal surveys.

It would seem that the most desirable method would be to set up a program whereby the personnel and funds would be contributed by a group of agencies. This method has been used very successfully for the past 7 years by the Cleveland Regional Geodetic and Underground Survey.[1] A number of changes in administrations have taken place during

[1] See Bulletin of the American Congress on Surveying and Mapping, April, 1944.

that time in the City of Cleveland in Cuyahoga County, and in the State of Ohio. These changes have had little or no effect on the organization. Of course there have been instances where a party chief, loaned to the Survey by some agency in the county after an election, found himself on the pay roll of the City of Cleveland, but in most cases he was back on the Survey at his old job in a few days. The political squabblings naturally exist, but have never been known to affect the complete cooperation of all the agencies.

Another method which may prove just as successful is to contract for the work with some private engineering firm specializing in surveys of that type. It would still be desirable, however, to have the cost shared by a number of agencies. The contract method has the advantage of the work being done by specially trained personnel and the agencies involved being relieved from the purchasing or borrowing of special equipment. In that connection, it might be well to consider that a large number of our universities have the type of equipment needed and are frequently able to provide personnel on a part-time basis to assist in training the field and office crews. The U. S. Coast and Geodetic Survey has for a number of years been of great assistance in advising cities how best to go about making such surveys and in a number of cases has loaned personnel and equipment. After the war, it is hoped that they will be able to go still further and perhaps provide a certain amount of the horizontal and vertical control needed. As regards personnel, a number of universities are turning out graduates with good basic training in higher surveying and mapping. Our soldiers are receiving extensive training along these lines. It would be well for our public agencies to make a point of hiring men after the war that have good surveying and mapping training.

* * *

Aerial Mapping Project for California Urged

AERIAL MAPPING of California as a postwar project was discussed in Sacramento recently at a conference called by the State Reconstruction and Reemployment Commission.

Col. Alexander R. Heron, director of the Commission, stressed the necessity for early planning to prepare a program of aerial mapping which can begin at the conclusion of the war, a program which will combine the facilities of the Army Engineers, federal and state agencies and civic groups.—*American Aviation,* December 15, 1944.

Latitude and Longitude by Series of Altitude Observations

By CAPTAIN F. B. T. SIEMS
U. S. Coast and Geodetic Survey

SIMPLIFIED astronomic observations on land for the determination of latitude and longitude may be patterned after the practice of position finding at sea—namely, that of observing altitudes of celestial bodies in various directions.

In the method herein proposed, the theoretical altitudes and azimuths of celestial bodies for an assumed position are computed to determine, as in nautical practice, the altitude intercepts (differences between computed and observed altitudes) and the directions along which the intercepts are applied. However, instead of determining the position graphically from the resulting lines of position, determination is obtained from computations involving the altitude intercepts and their azimuths.

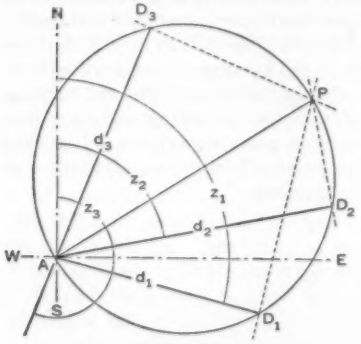


FIGURE 1

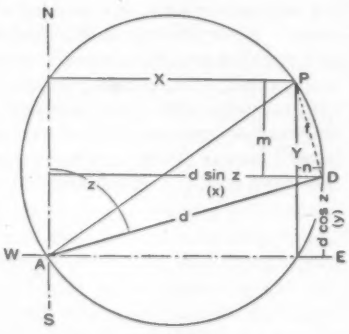


FIGURE 2

In figure 1, let A represent the assumed position, and d_1, d_2, and d_3 altitude intercepts applied along azimuth lines AD_1, AD_2, and AD_3. If the observations are without error, the resulting lines of position, D_1P, D_2P, etc., will intersect in a point at P—the position sought. It should be noted that P lies in a circle drawn through the points A, D_1, D_2, and D_3, and is diametrically opposite A. In the case of intercept d_3, the azimuth to the celestial body, as represented, is such as to bring the intercept in an opposing direction from the assumed position.

Referring to figure 2, let A represent the assumed position, d any alti-

tude intercept along azimuth z, P a point diametrically opposite A in a circle drawn through A and D, and X and Y the coordinates of P with respect to North-South and East-West lines through A. Then

$$X \sin z + Y \cos z - d = 0^*$$

in which X and Y are unknown variables and d and z known constants.

The observation equations resulting from n sets of a series of observations are therefore as follows:

$$\begin{aligned}
X \sin z_1 + Y \cos z_1 - d_1 &= v_1 \\
X \sin z_2 + Y \cos z_2 - d_2 &= v_2 \\
X \sin z_3 + Y \cos z_3 - d_3 &= v_3 \\
\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\
X \sin z_n + Y \cos z_n - d_n &= v_n
\end{aligned}$$

These equations are solved by the method of least squares for the most probable values of X and Y (see form). By this process the mean circle along the points at the ends of intercepts is derived. X and Y applied to the geographic coordinates of A will give the position sought.

This method was used by an Engineer Officer of the Coast Guard, in Newfoundland, upon suggestion of the writer. About 50 sets of altitude observations of the sun were made at intervals during an entire day with a Berger mountain transit (R and L vertical circle readings made to the nearest 30 seconds of arc). Unfortunately, an unreliable time-piece was used and only one time comparison was made, which was at the beginning of the observations. For this reason only the sights taken prior to about 1:00 P.M. were accepted. The astronomic position as determined by this method differs by 2 seconds in longitude and a fraction of a second in latitude from a geodetic determination based on charted objects in the vicinity. This comparison, of course, does not take into account the deflection of the vertical, which in this area may be of the order of 5 or 10 seconds.

Greater accuracy would result in the use of stars, particularly if with each star another is observed at approximately the same altitude but bearing in the opposite direction—to eliminate to a large extent any residual

---

* Referring to figure 2,

$$\begin{aligned}
X^2 + Y^2 = (AP)^2 &= d^2 + f^2 = d^2 + n^2 + m^2 \\
&= d^2 + (x - X)^2 + (Y - y)^2 \\
&= d^2 + x^2 - 2xX + X^2 + Y^2 - 2yY + y^2
\end{aligned}$$

or, $d^2 - 2xX - 2yY + x^2 + y^2 = 0$

Now, $x^2 + y^2 = d^2$

Therefore, $2d^2 - 2dX \sin z - 2dY \cos z = 0$

$$d - X \sin z - Y \cos z = 0$$

$$X \sin z + Y \cos z - d = 0$$

error of refraction. In this regard reference is made to figure 3, in which A represents the assumed position, d_1 and d_2 altitude intercepts for star S_1 bearing westerly and star S_2 bearing easterly, and d_3 and d_4 altitude intercepts for star S_3 bearing southwesterly and star S_4 bearing northeasterly, both stars in each case having approximately the same altitude. The circle shown is assumed to represent the mean circle resulting from

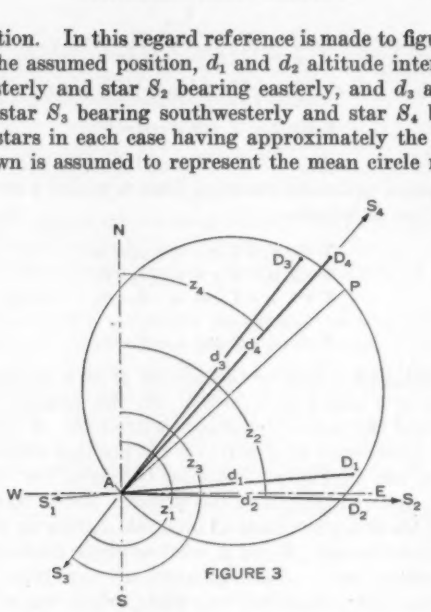


FIGURE 3

least square computations involving the four altitude intercepts and their corresponding azimuths. Assuming that the observations are without error except for residual refraction, the ends of both of the intercepts (D_1 and D_3) applied in directions away from the stars would either fall inside or outside the circle, and the other two (D_2 and D_4) would both fall in the reverse manner respectively outside or inside the circle, and their distances from the circle along the azimuth lines would provide a measure of the residual refraction.

Advantages of Method

This method of observation was originally intended to provide a simple procedure for determining latitude and longitude. Otherwise it is considered to have further advantages over the approximate methods commonly used for determining latitude and longitude separately, that is, by observing altitudes of celestial bodies on or near the meridian for latitude, and on or near the prime vertical for longitude. The method makes use of any and all altitudes observed in various appropriate directions, and each observation plays a part in the determination of (1) latitude, if the

celestial body happens to be in the direction of the meridian; (2) longitude, if in the direction of the prime vertical; or (3) both latitude and longitude if in an intermediate direction.

No preliminary data pertaining to the direction of meridian or prime vertical nor pertaining to local time is required. If desired, azimuth observations may be made along with the observations for latitude and longitude. Only approximate values of the latitude and longitude for the assumed position are required. These approximate values may be refined after computing two or three altitude intercepts for the first assumed position, in order to employ a revised assumed position closer to the position sought, thereby avoiding large values of altitude intercepts.

Form for Least Square Computation

Observation Equations

$$X \sin z_1 + Y \cos z_1 - d_1 = v_1$$
$$X \sin z_2 + Y \cos z_2 - d_2 = v_2$$
$$X \sin z_3 + Y \cos z_3 - d_3 = v_3$$
$$\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot$$
$$X \sin z_n + Y \cos z_n - d_n = v_n$$

($v_1, v_2, v_3, \ldots v_n$ are resulting errors in observations with respect to $d_1, d_2, d_3, \ldots d_n$)

[In the table a is defined as $\sin z_i$ and b as $\cos z_i$, where i varies from 1 to n. Σ equals sum.]

a	b	d	aa	ab	ad	bb	bd
$\sin z_1$	$\cos z_1$	d_1					
$\sin z_2$	$\cos z_2$	d_2					
$\sin z_3$	$\cos z_3$	d_3					
.....	.....	.....					
$\sin z_n$	$\cos z_n$	d_n					
		Σ					

Normal Equations

$$\Sigma(aa)X + \Sigma(ab)Y - \Sigma(ad) = 0$$
$$\Sigma(ab)X + \Sigma(bb)Y - \Sigma(bd) = 0$$

"ROMAN SURVEYING INSTRUMENTS"

This is the title of a 27-page pamphlet (price $0.75) by Edward Noble Stone, published in 1928 by the University of Washington Press, Seattle. It consists of a short general description of the principal instruments used by Roman engineers in land surveying and leveling.

Key to a Better Understanding of Maps*

By CAPT. WILLIAM H. GILL

EDITOR'S NOTE.—This is the introductory article in a series of articles by the author dealing with this subject to be published in The Military Engineer.

THE genesis of cartography is thought to be as ancient as man himself. Certainly the art is as old, if not older, than chirography and is shrouded in equally as much obscurity as the invention of the letters of the alphabet. The art of writing began with the symbolic picturization of objects, but it may be assumed that long before letters were invented, man had become sufficiently advanced in knowledge to be able to represent the relative position of countries, settlements, grain-fields, the course of large rivers, and the location of the great mountain barriers.

Although one of the earliest maps of record is that of the ground plan of Shushan of the Bible, assumed to have been made as early as the seventh century B.C., such sketches were quite deficient in geographic values as we know them today. The Egyptians had maps of their known world and ground plans of private holdings at an early date, as shown by a scene painted on the walls of the tomb of Monna at Thebes depicting the process of land measurement, at a period about 1300 B.C. The Greeks contributed much to our knowledge of geographic maps and the Romans advanced the art of cartography in turn, although it all but died out during the so-called "dark ages" of Europe. During this period it was nurtured by the Arabs who, by fostering and preserving Claudius Ptolemaeus' *Geographia* which in that day was the sum of all geographic learning, thus rescued the science from complete oblivion. It was, however, due to Mercator and his ingenious projection of the earth's surface, conceived about 1569, that the science of map making rose to new and greater heights than ever before. Although the history of cartography is a fascinating study, it is not considered absolutely essential to a better understanding of modern maps; hence, it is presented but briefly.

As one writer has aptly phrased it:

> Whoever has a knowledge of cartography is convinced that it is infinitely more difficult to compile a good map than it is to write a good book. In the latter situation one does not need seriously to torment himself with precision because, where ideas fail, it is easy to shirk obstacles by the skillful employment of words and phrases. An author can amplify and qualify his work, while the cartog-

* Reprinted through the courtesy of The Military Engineer, February 1945.

rapher must meditate and aspire to cast his material at hand to meet the exacting requirements of a given standard and form.

This does not imply, however, that all maps are not without fault, as there are good, indifferent, and bad ones. Discernment, discretion, and experience are essential if one distinguishes between them and chooses wisely. The determination of their relative dependability is of first importance, if the fullest use-value of the map selected is anticipated in the project at hand.

Everyone, whether he be the soldier, scientist, or layman, feels at one time or another the need for a map in the solution of his problem. Considering this universality of maps and map uses, it appears odd that both the making and interpretation of them should still be regarded by so many as being shrouded in mystery. To some individuals, cartography is a science involving the employment of strange and expensive instruments, acquaintance with higher mathematics, and the almost unattainable perfection and precision in the use of the drafting pen. Therefore, it is not surprising that we still find many military strategists, geologists, botanists, and other scientific men, whose study is essentially of the distribution type, who are not sufficiently versed in adequate cartographic delineation or intelligent map interpretation. Although the demand for instruction in map reading and field sketching (appreciably stimulated during the last 25 years by the World Wars) has led to the establishment of courses in surveying and cartography in many of our colleges and technical schools, a comparative few of our nationals are able either completely to understand or to make the fullest possible use of maps, especially maps of the topographic or contoured variety.

Map Interpretation

There is nothing mysterious about a map. Its relative uses and comparative values should be apparent to anyone who has ever conscientiously gone into the matter of its inception and preparation. A map is but a conventionalized picture of the ground, of either the whole or a part of the earth's surface, properly oriented by either a projection of latitude and longitude or a directional arrow, drawn to a given unit scale of linear measurement, and embellished by signs and symbols representing its physical and political aspects, drainage, culture, and settlement. It can be read easily and interpreted readily, providing the reasons underlying its purpose and its component parts are either understood or may be deduced from the legend appearing thereon. To be of the utmost use-value, however, a map must be accurate, graphic, and drawn to a definite scale, and must embody the following essentials: the type of projection upon which it is constructed; the variation of the magnetic

needle for the specific area covered; the date of its compilation; and the author or office of issuance. Without any one of these attributes, it may lose so much in ultimate value that it might be likened unto a ship without either a rudder or a destination. Actually the map is a technically adapted model of the component surveys of the earth, represented in miniature; hence, its interpreter must either accept or reject the whole as a certificate of scientific reproduction of its prototype.

Cartography, in general, may be segregated into two great family groups: terrain mapping, and hydrographic or maritime charting. The former is concerned primarily with presenting the exposed portions of the solid earth, while the latter shows the water-surface and the depths of the submerged terrain. Terrain maps, in turn, fall into two sharply divided classes: planimetric, or those showing the composite picture of the earth's surface on a flat plane only; and topographic or relief maps, those showing the elevations above the datum plane by contours, hatching, or crayon shading. Hydrographic charts show the surface area of the oceans and seas, the configurations of the coastal lines, and water depths by either sounding recordings or submarine contours, or both. Thus, both the topographic map and the hydrographic chart are third-dimensional, in that the one shows height above the datum plane and the other, inversely, depth below that plane, in addition to the other two cardinal dimensions.

Most persons are not sufficiently versed in the distinction between maps and charts, although it is hardly conceivable that even the most untutored in cartography would refer to "uncharted plains" and "unmapped seas." In extenuation of such possible error in reference, however, there exists a distinct overlap in the implication of the two terms, as the art of map making is called cartography from the French *carte* and the German *karte,* meaning map in both instances. There exists a neutral ground in actual execution, however, for the hydrographic chart may, and often does, show the configuration of the coastal lines and presents adjacent topographic forms in sufficient detail to make clear all possible aids to coastwise navigation. In addition, it may also show the submerged contours of the ocean bed and present possible navigational dangers in the form of reefs, shoals, and rocks periodically exposed during tidal fluctuations. The land surveyor and the hydrographer each has his distinct and divergent sphere of activity, however, regardless of the instances in which their products borrow, one from the other, largely for the convenience of the map user.

Importance of Map Knowledge

That this nation is becoming appreciably map conscious has been amply demonstrated by the voluminous matter published on the sub-

ject in various technical magazines during the past decade. Such publication is a healthy reaction to the stimulus given cartographic effort by the Federal Government following the declaration of the present war, through the medium of increased appropriations for military mapping. Maps have, since then, played a major role in the successful operations conducted in the far-flung theaters of war. It has been truthfully written that military necessity first compelled the production of a map, but it may with an equal measure of truth be stated that maps undoubtedly play a most important role in the peace, in those eras of reconstruction and exploitation which invariably follow in war's wake.

Postwar activities, and in particular those involving cartography, will undoubtedly bring with them a great many perplexing problems to those who plan to participate. It would, therefore, appear wise that we of the home front prepare now for the impending crisis by catching up with and keeping abreast of the times and developments, if we desire to be of assistance in the era of peace and prosperity which is bound to ensue. Surveying and cartography are foremost among the important activities contributing to the re-establishment and maintenance of normal industry and to our pride in our country, for which we have fought so many times. Although our citizens are truly map conscious, they are also to a great extent extremely map ignorant. A campaign of education is strongly indicated in this field. It has been often quoted that "a little learning is a dangerous thing"; this truthful saying is one particularly appropriate right now, where mapping is concerned.

It is deplorably true that but a comparatively small number of our citizens either understand or, seemingly, appreciate the relative use-value of maps as they should. Such a situation has been made evident by the numerous and often incongruous requests made on the federal mapping agencies during the past few years. These requests are for types of maps which have never existed, for sizes and scales of maps that are ridiculous, for a combination of research data which could not possibly be incorporated in one compilation, and upon governmental agencies that have never existed. This situation is probably traceable to the fact that, to the average layman, a map is but a map, regardless of its type, class, or the specific purpose for which it was drawn. The proscribed and widely divergent operational fields and functions of the map-making agencies and the specific purpose for which each type and class is designed and constructed appear to be neither known nor appreciated by the vast majority of those seeking maps and map information. Maps do not spring spontaneously and in a haphazard manner into existence overnight, but must be first care-

fully planned in the several administrative offices, then accurately surveyed in the field or compiled in the office and, finally, painstakingly refined in drafting by the cartographer through weeks or even months of effort over the drafting table, before they go to the engraver for reproduction and eventual distribution. That these processes are time-consuming is made evident in the fact that, ofttimes, copies of maps are not available for distribution for a year or more after the field surveys are completed.

Much of the perplexity on the part of those seeking information on maps and map sources may be attributed to a definite lack of knowledge of cartography in general, but such deficiency is not confined solely to either the citizenry of our nation or to state and county officials; it actually exists to an alarming extent in the offices of many of the federal bureaus in the nation's capital. Two factors which may be contributing to this situation at the present time are: first, the exigencies of war have caused many new mapping agencies and cartographic groups to mushroom into existence virtually overnight and the confusion thus occasioned, and the necessarily confidential status of their activities and products have contributed toward the limitation of the informational field on the part of those bureaus which formerly functioned in a normal manner; second, very little of an educational or informational nature on maps, in general, has ever been prepared or made readily available by the governmental agencies to those who might be interested. As such knowledge and information is essential to a better understanding of maps, its withholding can only further aggravate the feeling of impotence on the part of those citizens who seek data.

Federal Informational Services

This situation, so long either not recognized or at best minimized in importance, has now developed into an urgent need, not only to the citizens of this country and to state, county, municipal and private engineering enterprises, but also to many officials and nationals of those neighboring countries both to the north and to the south of us. Stringent but necessary paper-saving directives and mailing-list curtailment have, too, contributed their share toward creating the extreme paucity of map informational services at the present time and these are believed to have reacted primarily against the juvenile population of elementary school age. It would appear desirable, therefore, that such informational services be re-established, placed on a firm footing, and stressed, at the earliest practicable date, if we intend to keep abreast of the rapidly changing aspect of the world of today.

It is erroneous to assume that knowledge of the issuance of a map or chart will, eventually, reach the public by word of mouth or by corre-

spondence reference thereto. Neither is it practical nor expedient to assume that information on some specific map will be made available through the random request of the seeker, upon whichever bureau he believes to be the correct office of issuance. Strange as it may appear, however, these same methods of map and information dissemination have, for years, been the only recourse open to those seeking such data. Several of the federal bureaus prepare catalogs or lists of their maps and charts, but these may be obtained only upon request from the proper office of issuance of the specific map desired. Other bureaus do not prepare such lists for general distribution; hence, it is difficult for the average person to learn of their maps except through correspondence or hearsay.

It is this lack of a centralized office of map distribution and information which demonstrates the great need for the issuance of some sort of a comprehensive catalog listing, describing and, if possible, illustrating the more general types of maps produced by governmental agencies. The larger commercial and institutional map establishments of this and other nations came to an early realization of the necessity for advertising their products and, as a result, have for years prepared and distributed, free of cost, the most complete and graphically illustrated catalogs and indexes imaginable. Many of these publications present reduced replicas of their more outstanding products, reproduced by multi-color printings, and these operate to enhance greatly both their use-value and sales volume. Although it is true that the Federal Government does not enter the competitive field of map production, dissemination, or sale, it is equally true that it is, or should be, one of the primary functions of government to make readily available to the greatest number of its interested citizens, the products of its mapping activities in which national funds have been expended. The responsibility of federal procedure should not end with the mere production of a map, but should terminate only after such a product has been made known and available to those of its citizenry who might profit most through its use.

Simplified Time Chart

A SIMPLIFIED time chart of the world compiled by Lt. Comdr. Charles M. Thomas, U.S.C. & G.S., has been published in pocket form by Cornell Maritime Press, New York. It consists of a map of the world marked off in 15-degree longitudes to indicate the various time zones. Diagonal noon and midnight lines show how these periods progress around the world. The chart not only shows at a glance what time it is anywhere else in the world when it is a certain time at any given place, but can be used in connection with a Greenwich chronometer to determine longitude.—*American Aviation*, March 1, 1945.

Surveying and Mapping at Civil Aviation Conference

By LIEUT. COMDR. PAUL A. SMITH*

SURVEYING and mapping were actively represented at the International Conference on Civil Aviation. One of the 12 technical subcommittees responsible for the annexes to the Final Act of the conference was charged with "Aeronautical Maps and Charts." Its purpose was to consider the minimum standards for aeronautical charts to be required for aircraft engaged in international air commerce.

Representatives from 23 countries participated in the work of the International Committee on Aeronautical Maps and Charts.

The final report of the committee recommended the following series of charts:

(*a*) A basic aeronautical chart for general operation, contact flight, and related aeronautical purposes. It shall comprise the sheets of the 1:1,000,000 scale charts of the world aeronautical chart index produced by the United States of America for military aviation, with such subsequent alterations as experience may require, and as may be agreed upon in the future.

(*b*) Air Navigation Charts for use in long flights shall be constructed on a scale not smaller than 1:5,000,000 on either Mercator or Lambert conformal conic projections.

(*c*) Air route charts, covering the major airways, shall comprise charts in strip or book form to a scale not smaller than 1:2,000,000 and on that scale covering in general a width of not less than 100 miles on each side of the centerline of the airway, currently revised and printed to accommodate the changes in airway facilities.

(*d*) Local charts, of terminal areas and important traffic centers, shall comprise charts of suitable size and scale to insure safety in operation and traffic control procedures under the most exacting forms of instrument approach and let-down procedures permissible in the area.

(*e*) Skeleton charts for special purposes may be produced from the black and drainage plates of the basic aeronautical chart scale 1:1,000,000 or other series, in such form as subsequent developments of air navigation devices may require.

The final report of the Committee further prescribed the detailed specifications for the International Series of 1:1,000,000 scale aeronautical charts produced by the United States for military aviation.

* Chief, Aeronautical Chart Branch, U. S. Coast and Geodetic Survey; Chairman, International Committee on Aeronautical Maps and Charts at the International Civil Aviation Conference, Chicago, November 1944.

These specifications appear in the Final Act of the Conference as Annex J. This establishes specifications in detail for an international aeronautical chart; and these specifications are based on experience of the aviators of the United States of America. The same series of charts was recommended in Resolution 15 adopted by the Second Pan American Consultation on Geography and Cartography held in Rio de Janeiro, August 1944.

Lord Swinton, Chairman of the British Delegation, paid high tribute to the work of all the technical committees at Chicago. He specifically mentioned the aeronautical chart work of the Americans in his speech on Civil Aviation made in the House of Lords, January 16, 1945:

> . . . Then there are maps and charts which the pilot has to use. Your Lordships are familiar with the infinite variety of maps which you get in one country and another. Not only are they printed in different languages, which I suppose is necessary, but all the signs on them are different. One symbol means a "pub," in one language and a church in another and that must be very inconvenient for those who want to find one or the other. And there are other examples. The object of this is that eventually we shall get every map a pilot uses drawn in the same way. He will be able to buy a map anywhere he goes. It will look the same, it will be to the same scale, the symbols on it will mean the same things. We were fortunate in finding a magnificent job of work done by the United States in the great system of charts which they got which we have taken as the basis of this international work. Of course, we shall have in addition air navigation charts for long air flights, air route charts in strip or book form, and local large-scale charts of special areas.

The Final Act of the International Civil Aviation Conference, which has been signed by 54 attending Nations, provides for an interim or provisional international civil aviation organization with a permanent Secretariat. Each one of the technical annexes drafted at the conference is to be represented by technically proficient persons on the Secretariat, and tentative committees have been formed in the United States for preparing such necessary amendments to the Final Act of the conference as the United States may propose from time to time.

Aeronautical charts are obviously to be classed in one of the most active divisions of all of the field of surveying and mapping. In the production of the world-wide series of aernonautical charts used during this war by military aviation, the United States of America has taken the greatest step forward in chart production that has ever been taken by any single nation in the history of the world.

In his concluding remarks, as Chairman of the Committee on Aeronautical Maps and Charts, the writer made the following statement:

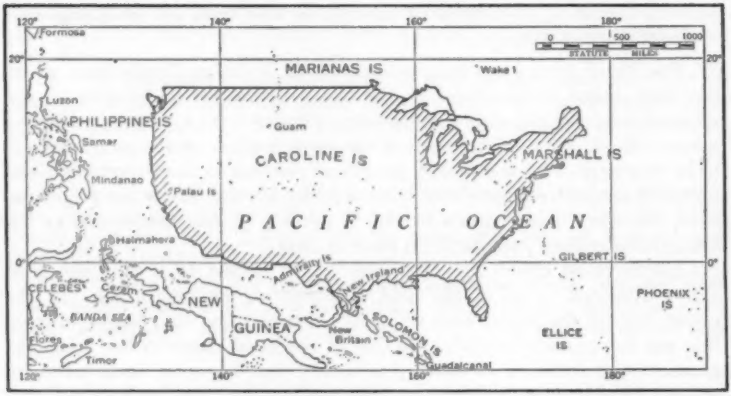
> The international aeronautical chart of the world produced by the United States, and which has formed the basis of the deliberations of this Committee, can be considered in a very real sense as an international development rather than the

sole achievement of any one country. The actual production of this chart, it is true, has been accomplished in the United States, but only because the events leading up to the need for this chart by chance placed the United States in the position of the producer. The chart comprising more than 1,200 sheets has been made possible through the contributions of many nations in the form of published source material, unpublished surveys, aerial photography, and the great variety of information and data needed to make a modern aeronautical chart.

We do, therefore, like to think of it as an international achievement in which we of course take national pride; but more important we believe is the responsibility for its continual maintenance by revision and correction. This responsibility, we believe, can be carried out most effectively through the international aviation body which we hope will be the outcome of this Conference.

❦ ❦ ❦

"THE PACIFIC ISLAND WORLD"



(The ease with which the United States can be tucked away in this corner of the Pacific emphasizes the extent of this vast ocean. Covering more than one-third of the earth's surface, it is larger than the entire land area and contains more than 68 million square miles. Two more maps of the United States could be placed between the Marshall Islands and the California coast.)

The Land Surveyor and the Geologist*

By C. D. BROWN *and* F. D. SHEPHERD

C. D. BROWN.†—One compensation for the horrors and miseries of the surveyor's life is that he travels in queer places and encounters queer people. Take geologists, for example. They need not be offended at being labelled queer. Indeed the whole human race is queer. A detached observer, say from our neighbour Mars, watching our antics would be convulsed with laughter when not moved to tears.

To get back to the geologists. Their outstanding queerness is a passion for ten-dollar words. Even their simplest statements are wrapped in verbal camouflage. The consequence is that the simplicity is lost and the layman bewildered. I suspect this is deliberate. No self-respecting geologist will commit himself to a definite statement. It is against his principles; indeed no one trained in that highly speculative science could be otherwise. Ask a geologist if there is "gold in them thar hills" and his reply, stripped of its verbal shrubbery, would be that maybe there is gold there, maybe; and yet on the other hand maybe there is no gold there, maybe: best go and find out for yourself.

Another queer trait of the geologist is one that he shares with the weasel.

I read somewhere that once a weasel starts on the trail of a particular rabbit, nothing will deflect him. He may pass other equally fat bunnies within easy reach but they do not tempt him. He pursues his chosen prey to its doom. So the geologist. If he is examining an area for precious metals, weasel-like, he sticks to his task. Should a mountain of copper loom up he will ignore it. He is not looking for copper so he refuses to see it. I had better stop talking about geologists. I see one in the audience and presently he will be chasing me out into the street and doing me in with a hammer.

Just one more word. The other day I acquired a charming little book called—university professors please note—"Calculus Made Easy." It's a honey. The author undertook to debunk the calculus and to rob it of the mystery with which the professional mathematicians love to be-devil it. Did he do a good job? I'll say he did. Even I understand it. Won't some geologist desert the rarefied atmosphere he frequents long enough to write a "Geology Made Easy." I promise to read it, and hav-

* From "People You Meet" and "The Geologist Replies to the Land Surveyor," printed in The Canadian Surveyor, April 1944.

† Extract only.

ing done so I admit now I shall probably have to swallow my words and retract at least a little of the foregoing nonsense.

F. D. SHEPHERD.—I submit that the speaker has taken unfair advantage of a guest, not that his remarks are untrue, but that he has neglected to provide him with adequate opportunity for rebuttal. Therefore as my reply is of necessity of an entirely spontaneous nature, I must beg your kind indulgence in my remarks.

In his comedy, "As You Like It," Shakespeare has, in Act 5, Scene 4, indicated a classification of the degrees of severity to be applied in a reply to such an accusation as the speaker has just made. I shall list them: We have (1) the "retort courteous"; (2) the "quip modest"; (3) the "reply churlish"; (4) the "reproof valiant"; (5) the "countercheck quarrelsome"; (6) the "lie with circumstance"; and (7) the "lie direct."

The relationships which have existed in the past between land surveyors and geologists have been of an harmonious nature, but it has been decided that were a "retort courteous" to be applied, the present circumstance might prove to be of a recurrent nature; the "reply churlish" appears somewhat too violent and unbecoming to the dignity of our profession, as do the succeeding degrees. Consequently, I shall have to content myself with the "quip modest" which appears to be the most convenient vehicle at hand.

I hasten to agree with the observation that geologists are a queer lot. I have even noticed that myself. I frequently encounter difficulty in convincing other geologists as to the correct interpretation to be placed on some of my own speculations. With the venerable Quaker in his conversation with his aged spouse, I am often tempted to concur and conclude that all of my colleagues are queer, myself constituting the sole exception in the profession. But that our idiosyncrasies are so patent and obvious as to be noted by a land surveyor is unthinkable and is demanding of immediate correction.

It is also true that the geologist basks in the transports of a higher etymological plane, and not without reason. Bridges must not be burned behind one. To illustrate:

One day while in the company of one of the members of your association, the rusty, completely decomposed remains of what was formerly a hollow iron post marking a section corner was located by carefully paring thin slices of clay from an area within the limits of four pits. The monument was duly restored, and its discovery was recorded by such a simple method as:

"Found trace I.P. and pits. Planted I.P."

The naive simplicity of this recording was so repulsive that I resolved then and there upon a geological career which would enable me to place

proper emphasis on the importance of natural processes and phenomena. The proper recording of this discovery might have been described in the following manner:

The purpose of the following investigation was to ascertain, if possible, within reasonable limits of accuracy, the location of a metal (wrought iron) rod of approximately ¾-inch diameter and 36 inches in length, reported to have been sunk, planted, driven, punched, pushed, or otherwise placed at a point which may be described as being the northeast corner of section 21, township 5, range 10, west of the second meridian.

The area surrounding the site of the investigation is underlain for the most part by sedimentary deposits of Recent and Pleistocene age which rest with a slight angular disconformity upon a series of argillaceous silts and sandstones (calcarenites) that have been temporarily assigned to the Paleocene (a series of transitional sedimentary rocks which appear to bridge the hiatus marking the close of the Mesozoic and the beginning of the Tertiary).

Evidences of Pleistocene glaciation are to be abundantly observed in the many excellent moraines, kames, eskers, drumlins, and perched boulders which have been locally masked by recent occurrences of varved clays and a series of fine silts, which may be of aeolian, fluviatile, lacustrine, or marine origin. Time at the disposal of the investigator did not permit of conclusive classification, but the area is recommended as being one worthy of further study.

Having arrived at the site of the investigation, it was decided that the optimum method of research likely to yield desirable results was to microtome the superincumbent till.

Upon the removal of approximately six to eight inches of humified glacial till, sections of calcareous boulder clay were obtained. An area of approximately two square yards of the above material was exposed which showed evidence at one point of being slightly contaminated by a small quantity of limonite or geothite. It was therefore considered feasible to direct further investigation to the possible downward continuity of this geothite, with the hope that criteria of a more definite diagnostic nature could be obtained. Sectioning was continued until there was exposed an annulus of limonite whose perpendicular continuity was definitely established.

It may be then stated with reasonable certainty that the former position of the object of our investigation was indicated, and it was deemed reasonable to assume that a similar object placed in a similar position would, in all probability, represent a reasonably close restoration of the former iron post. This conclusion was reached after giving due consideration to the fact that in all likelihood ground water circulating through the vadose zone had exercised an oxidizing or a metasomatic effect upon the elementary iron, producing a metamorphosis by meteoric or supergene agencies, resulting in the production of the geothite now constituting the principal constituent of the afore-mentioned annulus.

And you have the temerity to suggest that geologists are queer!

Federal Surveying and Mapping Agencies

This is another in the series of sketches of the history, purpose, and scope of activities of federal agencies engaged in surveying and mapping.—EDITOR.

U. S. GEOLOGICAL SURVEY*

Department of the Interior

HISTORICAL

THE United States Geological Survey was established by act of Congress approved March 3, 1879. Prior to that date, five federal Surveys had been engaged in mapping portions of the territory of the United States. The oldest of these, the Coast and Geodetic Survey, had restricted its mapping to the coastline, but had extended certain geodetic and scientific investigations over various parts of the country. The other four organizations had made topographic, geologic, and other scientific and economic surveys in the Territories west of the one hundredth meridian.

When the Geological Survey was created all of these earlier Surveys except the Coast and Geodetic Survey were discontinued.

The organic act creating the office of the Director of the Geological Survey reads, in part, as follows: ". . . this officer shall have the direction of the Geological Survey, and the classification of the public lands and examination of the geologic structure, mineral resources, and products of the national domain."

The first director, Clarence King, interpreted this act to call for "a rigid scientific classification of the lands . . . for the general information of the people and for the production of land maps that should show all those features upon which intelligent agriculturists, miners, engineers, and timbermen might thereafter base their operations and would obviously be of the highest value to all students of the political economy and resources of the United States." On August 7, 1882, the meaning of the "national domain" was clarified by an act of Congress which authorized the Survey to "continue the preparation of the geological map of the United States." This was accepted as authority for the extension of the geologic and topographic surveys and other investigations to all parts of the United States.

During the first 2 years the work was organized under five geographic divisions, each of which was practically complete in itself, carrying on

* Prepared in the Director's Office of the Geological Survey.

geologic, topographic, and chemical investigations. By the third year, however, the need for adequate topographic bases for all mapping investigations became so clearly evident that topographic work independent of the geologic parties was begun.

During recent years, work involving topographic and planimetric mapping is largely confined to the Topographic and Alaskan Branches of the Survey, while geologic mapping is conducted by the Geologic, Alaskan, Water Resources, and Conservation Branches.

Geologic Mapping

A geologic map shows, either by colors or by different patterns, the extent and distribution of the rock formations. It is accompanied by an explanation or legend listing the formations according to geologic age and grouping them according to their origin—sedimentary, igneous, or metamorphic. The maps of mining districts also show such special features as veins and ore bodies that crop out on the surface. The geologic map may be supplemented by special maps showing the distribution of mineral deposits, the geologic details of mine workings, and other features of special interest.

When the Geological Survey was organized, the first problems in geologic mapping were in part inherited from previous organizations and were almost wholly confined to the lands west of the Rocky Mountains, and in part were the result of urgent demands for economic investigations of mining districts, particularly the Washoe and Eureka districts of Nevada and the Leadville district of Colorado. With the later extension of geologic work to the Eastern States, less and less attention was given to economic geology, while more was given to broad problems of geology as a scientific basis for the preparation of the geologic map of the United States.

The early geologic mapping was done mostly on scales of 1 inch = 1 mile and 1 inch = 2 miles, and was done in quadrangle units of one-quarter—or less commonly, one-sixteenth—of a square degree. The results were published in folios. Each folio consisted of a descriptive text accompanied by maps showing topography, areal geology, and economic geology, and by cross sections showing the underground extent of different geologic units. The first folio was issued in 1894.

During subsequent years, however, the demand for studies of economic projects reached such proportions that these important, basic investigations were curtailed through lack of sufficient staff to carry on both. The rate of folio publication declined until today the preparation of folios has been discontinued. Geologic maps of quadrangles are now published as folded plates in Bulletins and Professional Papers the texts

of which are more complete than was practicable in folio form. The plan to complete the geologic map of the United States is thus being continued.

Preliminary small-scale geologic maps of the United States have been prepared at various times in the past; the latest of these, on a scale of 1:2,500,000 (1 inch = 40 miles), was published in 1933.

A geologic map of North America was published in 1911 by the Survey, and a revised map, prepared in co-operation with the Geological Survey, is soon to be issued by the Geological Society of America. Geologic maps have been prepared of a number of the States, mostly in co-operation with State Geological Surveys.

The geologist uses, where available, a topographic map prepared by the Topographic Branch of the Survey as his base map in the plotting of his data. Most of these maps range in scale from 1 inch = 1,000 feet to 1 inch = 2 miles, and on a few maps for reconnaissance work even a scale of 1 inch = 4 miles is used. Special geologic and topographic maps of mineral deposits are commonly on very large scales, ranging from 1 inch = 500 feet to 1 inch = 50 feet.

Where applicable, magnetic and other geophysical surveys are made as supplements to geologic surveying, indicating the positions and trends of certain essential features where the bed-rock surface is concealed beneath deposits of alluvium, glacial drift, landslides, or talus. The information thus obtained, together with the cores or cuttings from drill holes, enables the geologists to construct maps of the concealed bed-rock surface and to make structure-contour maps essential in the study of oil fields and in the planning of underground work of different kinds.

In 1938, the Geological Survey began to focus its geologic investigations on the deposits of strategic and critical minerals; by 1942 it was devoting itself exclusively to these and other strictly war-urgent studies. This work has included the preparation of several hundred geologic maps of mineral-producing areas and single deposits or mines, primarily for the use of war agencies and mine operators. This work has been done, not only in the United States and Alaska, but also, under the sponsorship of the Department of State, in several of the Latin American republics.

As the war progressed, the need for new sources of petroleum to meet unprecedented war needs became increasingly evident and in 1943 the Geological Survey greatly enlarged the scope of its work in petroleum geology. Surface and subsurface geologic work has been in progress in more than 20 states since that date to obtain regional data needed for the selection of local areas suitable for intensive exploration by the industry. Maps and charts presenting the results of these investigations are published at the rate of about one each week. They provide a variety

of information on the distribution, thickness, and variation of possible oil- and gas-producing formations, geological structure, location of drilled wells and formations tested, and similar basic geologic data that will aid in the search for new fields.

Topographic Mapping

With the development of topographic mapping as a function of a separate Branch of the Geological Survey, in the third year of its existence, a broad base plan for a topographic atlas of the United States was adopted. This was so designed that all maps produced would be component parts of the whole; the unit map sheets were in quadrangle form bounded by meridians and parallels, the 1° quadrangle being the largest unit and the 15′ quadrangle the average unit. All quadrangles are constructed on the polyconic projection. The horizontal scales originally adopted were in terms of simple fractions of a million, and many early maps were made on scales of 1:250,000 and 1:125,000. However, as mapping progressed, demands grew for larger scales and the ratio of 1:62,500 was widely used. As the scales grew still larger and thus usable for engineering purposes, the fractional millionth scale was abandoned in favor of the English scale in terms of miles or feet per inch, scales which are in common usage by engineers. Thus the larger scales of late maps are 1:31,680 (2 inches = 1 mile) and 1:24,000 (1 inch = 2,000 feet).

The distinctive feature of the topographic atlas of the United States, of which the individual quadrangles are a part, is the delineation of relief by contours. Contour intervals vary with the terrain and the character and scale of the map. For the very small scales the interval may be as large as 250 feet. For maps on the scale of 1:62,500 in rugged terrain, 100-foot or 50-foot intervals are usual; other intervals are 40 feet, 25 feet, 20 feet, 10 feet, and 5 feet. A few special maps have been prepared with 1-foot intervals.

In addition to the preparation of the topographic atlas, the Geological Survey has carried on a reconnaissance mapping program in Alaska for many years in order to indicate the general nature of that formerly remote and undeveloped territory. Ordinarily these maps are published at a scale of 1:250,000 with 200-foot contour intervals. In highly developed or mineralized areas the scale of 1:62,500 has been employed with appropriate contour intervals. All mapping problems for this Territory are handled by the Alaskan Branch which at present is also engaged in reconnaissance mapping from tri-metrogon photography in various parts of the world.

The art of map making has undergone rapid evolution during the period spanned by the Survey's activities in this field. Early maps lacked adequate horizontal and vertical control, and the aneroid was widely

used to determine elevations above sea level. That instrument has now been largely replaced by spirit leveling and vertical angle observations. Networks of supplementary horizontal control, and the basic first-order triangulation net of the Coast and Geodetic Survey now reach into nearly every part of the United States, so that positions may be correctly fixed within 1/50 of an inch, or less, on the modern map sheets.

Within the past 25 years the Survey has participated intimately in the development of methods for the preparation of maps from aerial photographs. Its engineers have improved the design and the accuracy of cameras and of the instruments by which planimetry and relief are drawn directly from the photographs.

Nearly all of the more recent Alaskan mapping program has been accomplished by photogrammetric methods. Photogrammetry has contributed greatly to mapping progress in Alaska, as it permits full use of the short three or four months' summer season, and makes possible a rapid progress in a country so rugged and undeveloped that terrestrial mapping methods have become increasingly inadequate.

Personnel of the Geological Survey engaged in this type of reconnaissance mapping have developed several methods and instruments particularly well suited for the purpose; these instruments and methods have been employed by the armed forces in the present emergency. The tri-metrogon process, which has been developed by the Geological Survey with the effective co-operation of the Army Air Forces, has been utilized in rapidly compiling small-scale maps for world-wide requirements. During the past 3 years, maps covering more than 5,000,000 square miles of territory have been prepared by this method.

The methods employed in preparing normal topographic maps of any area are selected with a view to the greatest economy practicable. Aerial photographs are procured for all areas to be mapped. Stereophotogrammetric equipment and methods are employed where the relief encountered warrants the use of a contour interval of 20 feet or more, and in some cases where it is as small as 10 feet. About 14 percent of the topographic mapping by the Survey in 1941 was done by means of stereophotogrammetric equipment such as the Multiplex Aero Projector and the Aerocartograph. The remainder was accomplished by constructing planimetric maps from aerial photographs, and adding on these by planetable methods contours and all other details that could not be readily obtained from the photographs.

During the past 6 years 71 percent of the production effort of the Topographic Branch has been applied directly to the preparation of topographic maps of domestic and foreign areas requested or otherwise designated by the Army, and 29 percent of the effort has been devoted to the preparation of topographic maps needed for use in the search for

and evaluation of potential domestic supplies of strategic and critical minerals and materials, and to surveys in co-operation with the States outside of the strategic zone as defined by the War Department. Since July 1938, maps of 697 quadrangle areas in the strategic zone have been published.

Map Reproduction and Distribution

The Survey maintains its own map reproduction plant. Copper plate engraving is being used to a limited extent for the most intricate maps in whose accurate reproduction very fine, even, and closely spaced lines are required. For more open country, the more rapid and less expensive processes based on photography are used.

First editions of Survey topographic maps usually number about 3,000 copies. Successive editions are issued as needed. General distribution of maps is by sale. Most of the maps are sold at 10 cents per copy, a sum that covers the cost of paper and printing, but does not cover the cost of field surveying and reproduction. If maps are purchased in quantities, discounts are given. During the fiscal year 1944 nearly one and a half million individual sheets were distributed.

Publications

Many publications have been issued dealing with various phases of the art of topographic mapping. Perhaps the most important single publication on this topic issued by the Geological Survey is Bulletin 788, "Topographic Instructions of the U. S. Geological Survey," by C. H. Birdseye. As level lines are run in various portions of the United States, the data are assembled for the convenience of engineers and published as bulletins, usually covering the leveling that has been done in states or parts of states; for example, Bulletin 912, "Spirit Leveling in Utah." The results of traverses likewise are issued as bulletins.

Occasionally pamphlets are issued dealing with special phases of the Survey's work. Examples are "Aerial Photographic Mapping by the Geological Survey" and "The Use of Aerial Photography in the Making of Topographic Maps."

Professional Paper 60, "The Interpretation of Topographic Maps," prepared in 1908, comprises a selected set of topographic maps depicting different land forms and physiographic features, accompanied by an explanatory text; it has found extensive use in the classrooms of college and university geologic departments.

T T T

"Cursed be he that removeth his neighbour's landmark. And all the people shall say: Amen."

—Deuteronomy 27: 17

The Use of Balloons and Radios in Mapping*

By WILLIAM T. RYALL†

THE basic principle of the method that has been developed by the writer in the Little Rock District, United States Engineer Department, is to establish secondary mapping control by triangulation. This method eliminates the running of transit traverses and is based on a primary triangulation net of third-order accuracy. It has resulted in a

FIGURE 1.—Balloon beginning its ascent over tie point.

saving of 25 to 50 percent in the cost of such work. Here is given a summary of the main problems encountered in developing this method and their solution.

* Reprinted through the courtesy of The Military Engineer, December 1944.

† Assistant Engineer, United States Engineer Department.

Problems to Be Overcome

(*a*) The tie point to be established must be visible from three or more stations of known geodetic position, or a target must be raised to sufficient height above timber and intervening land masses in order to avoid obstructions to a clear line of sight from stations of known position. Since it is not practical to build towers or targets over the numerous tie points required for mapping control, this problem was overcome by the use of rubber balloons inflated with helium gas. (See fig. 1.) When these balloons are inflated to a diameter of 5 feet, they make excellent targets, which are easily observed for a distance of from 10 to 12 miles under favorable conditions, and will rise above any obstructions to a clear line of sight from the triangulation stations.

(*b*) Some means of determining when the balloon is on a true vertical line above the tie point is necessary. This problem was overcome by devising a simple collimator, which consists of a light tripod with legs 7

Figure 2.—The collimator stand.

feet long and an open metal head 7 inches in diameter with right-angle cross wires that intersect in the center of the head. (See fig. 2.) The tripod is set over the tie point by suspending a plumb bob from the intersection of the cross wires. A mirror about 8 inches square with a small dot in the center is placed on the ground underneath the tripod head, with the dot on the mirror directly under the plumb bob point and the mirror tilted at an angle that will permit a clear view of the reflected image of

the cross wires in the tripod head to a man in a standing position. The plumb bob is then removed, and the balloon, after having ascended to the desired height, is maneuvered by means of three guy strings into the projected vertical line between the dot on the mirror and the intersection of the cross wires. When the image of the cross wires appears to cut the image of the balloon in quarters directly over the dot on the mirror, the balloon is in a vertical position over the tie point. (See fig. 3.)

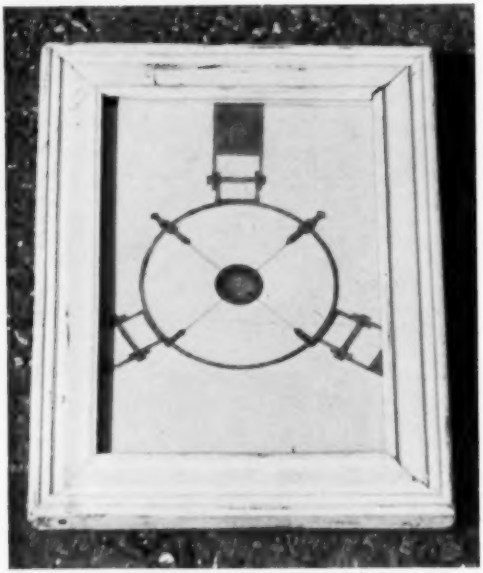


FIGURE 3.—Reflection of balloon in mirror when balloon is over tie point.

(*c*) The last major problem to overcome was to provide some practical and dependable means of communication, which is the key to the successful application of this method. This communication system is necessary to determine when the balloon has reached a height that will permit a clear line of sight from the triangulation stations. It is also necessary to inform the instrument men on the triangulation stations the moment the balloon is in a vertical position over the tie point and to know that the instrument men have made the necessary observations before the balloon is moved to another tie point. The balloon party, by means of this communication system, is the nerve center of the entire procedure in

applying this method, which requires approximately 15 employees who are spread out over an area of approximately 100 square miles at all times. This problem was overcome by the use of portable short-wave transmitting and receiving radios. The transmitters were designed and constructed to operate on a frequency of 2,300 kilocycles, which was specified by the Bureau of Communications. The receivers were the standard short-wave automobile-type used by police. Standard heavy-duty automobile batteries were used for power to operate both the transmitters and receivers.

Procedure

With these problems solved, it is now very easy to establish secondary control by triangulation methods. The instrument men, with their transits oriented over established survey stations, can sight the balloon at the moment that it is vertically suspended over a point to be tied in. As soon as they have sighted the balloon, they keep their transits focused on it and notify the operator of the balloon equipment by radio. When at least three of the instrument men have seen the balloon and when the operator gets the balloon vertically over the point, a signal by radio is given to the instrument men to clamp their instruments sighting the center of the balloon. The instrument men project their lines of sight on the balloon to a temporary point on the ground. When this is done, the balloon party is informed that the observation is satisfactorily completed, and the balloon is reeled down and placed in a cloth cover, without deflating, in the back of a covered survey truck to be transported to the next point to be tied.

While the balloon party is en route to the next tie point, the instrument men make the necessary angular measurements between the temporary point and the nearest triangulation station or reference point. From the angles observed by the instrument men it is possible to compute the position of the tie point. By having three instrument men make the intersection, a double tie of the point can be computed to eliminate errors and improve the accuracy by a mean of the results. If more than three instrument men make the intersection, even better results can be obtained. Two balloon parties are used when considerable time is required to travel between tie points. The amount of progress is practically doubled by following this procedure when control is being established in rough mountainous terrain.

Conclusions

Control for mapping can be established much faster by the described method than by ordinary traverse methods. Besides the saving in cost that is effected, there are fewer computations to make, the possibility of an error in the field work is almost entirely eliminated, and the results

are more accurate. The procedure becomes very popular with field personnel when they see that an increased amount of progress can be made with less effort than is required for transit traverse methods.

The method has not yet been adopted for general use by federal mapping agencies, largely because of the difficulty in obtaining the radios, the balloons, and the helium drums. It is believed, however, with the coming postwar mapping programs and the release of critical materials after the war, that the method will play an important part in expediting mapping surveys. It is the writer's belief that the principles of this method can be applied to locating targets for artillery firing and possibly for other military purposes.

* * *

New Surveying Instruments

MANY NEW surveying instruments have been developed for engineer use. One is a theodolite that reads to 1 second of arc. Its chief advantage is speed, for one reading of an angle gives the same accuracy as multiple turning of angles with the conventional transit. Another new instrument is the pendulum astrolabe, utilizing the principle of a pendulum defining the vertical rather than the normal to the surface of a pool of mercury, thus making it suitable for operation in extreme hot and cold weather conditions. It is an astronomical instrument that will determine the correct astronomic position of a point within 200 feet of absolute correctness. A new zenith camera for photographing the area around the zenith and also determining astronomic position from the stars is accurate within 300 feet of absolute.

Another greatly improved surveying instrument is a new type level, designed for fast use. The entire head does not need to be exactly level, as is the case with the conventional instrument, but when the telescope is placed in the line of sight it quickly can be brought to exact level by adjustment of a thumbscrew.—Harold W. Richardson in "How Army Engineers are Weaving the Sinews of War," *Engineering News Record*, Feb. 8, 1945.

Topographic Mapping with the Multiplex Aero Projector

By MILTON J. HARDEN*

TOPOGRAPHIC surveying is one of our oldest forms of surveying. Some of the oldest maps reflect very definitely the expression of relief by use of hachures and different methods of shading. Even today we frequently see maps on which the relief is expressed by use of hachures and, too, by use of form lines. Form lines, however, are to be distinguished from contour lines in that form lines are only approximate delineations of true contour lines. It is common practice to show form lines as a series of short dashes rather than by a solid continuous line, to indicate the fact that they are not contour lines.

The use of shading or hachures on maps of the continental United States is rarely employed at present. The fact that elevations may be obtained from a contoured map, whereas a shaded or hachured map merely shows the shape of the terrain without any attempt to establish differences in elevation, undoubtedly accounts for the preference for contoured maps. A map, on which an artist has expressed the true form of the earth's surface with hachures or other means of shading, is a thing of beauty, and one must admit that this type of map is very useful for certain purposes.

When we compare the methods and conveniences by which contoured maps are made today with those made several decades ago, we marvel how the difficulties which confronted our older engineers were overcome. Aerial photography, supplemented by precision aerial cameras and improved stereophotogrammetric equipment, has so modified mapping methods that contour mapping will cease to be the difficult job it has been in the past.

The Multiplex Aero Projector

One of the most widely used stereoscopic plotting instruments today is the Multiplex Aero Projector. This instrument is quite simple mechanically, yet it fulfills all the requirements that are needed to set up a plastic model of the terrain from which the operator can delineate the cultural, drainage, and hypsometric features that are usually represented in topographic maps.

The Multiplex instrument consists of a horizontal bar supported over a finely constructed table with a plane surface which represents to the operator the datum plane from which all measurements of elevation are

* Topographic Engineer, U. S. Geological Survey.

made. Supported on the bar are a number of miniature projectors which serve to project onto the table top the photographic images recorded on small glass plates which are greatly reduced positive copies of the aerial negatives. The projectors are equipped with controls so that they can be moved as desired in space and the diapositive plates inclined or oriented as necessary. A proper orientation of the projectors will enable the operator to perceive on a screen a three-dimensional model of the terrain common to any two overlapping aerial photographs. The Multiplex method employs the anaglyphic principle to separate the two projected images in order that the stereoscopic model can be perceived. The projectors, when properly placed on the horizontal bar, reproduce the successive positions of the aerial camera during a single flight of the airplane and to the desired scale.

The principle on which the Multiplex method is based is simple. It depends upon securing a true perspective representation on overlapping aerial negatives of the terrain exposed to the aerial camera and, from these negatives, reproducing in the office identical cones of rays. If the projectors are properly positioned, the operator can reestablish exactly

MULTIPLEX AERO PROJECTOR SET UP FOR OPERATION.

the direction of all light rays that formed the original aerial negatives, the rays from adjacent projectors intersecting in the same relative positions as they did in nature. While the method is simple in theory, it imposes very rigid requirements on the photogrammetrist if he is to reestablish these light directions with the desired accuracy.

Details on the map are drawn with a small instrument known as the tracing table. It consists of a horseshoe-shaped base with two upright standards to guide the motion of a small platen on which the Multiplex model is perceived. This platen has a very fine hole at its center which is illuminated from below to supply the measuring or floating mark that the operator uses in tracing out the map details. The operator, by moving the platen up or down, can cause the floating mark to apparently move up or down over the stereoscopic model. The height of objects can be determined by lowering the platen until the floating mark seems to come in contact with the surface of the model and then reading the elevation of the point from the vertical scale of the tracing table. A drawing pencil vertically below the floating mark is provided for use in the actual map drawing operation.

Operation of the Multiplex

Each Multiplex Projector is provided with micrometer controlling devices so that it can be moved in space in the X, Y, and Z directions and, moreover, it can be inclined or oriented as may be necessary to recover the tilt of the aerial camera.

The operator is supplied with a sheet of drawing paper upon which a polyconic map projection has been drawn and the horizontal control plotted, and also a list of known elevations of clearly defined objects that he can recover in the model. The small diapositive plates are then placed in the projector and adjusted in such manner that the principal point of the aerial camera, as represented on the diapositive plate, is brought into coincidence with the principal point of the projector and the plate is then locked firmly in this position. To set up the model with two projectors, the operator rotates each projector in turn until a stereoscopic impression of the ground surface is obtained. He then proceeds with a more or less routine manipulation of the tip, tilt, and Z motions of the projectors in the effort to remove the "parallax" from the model. Parallax in this case is considered to be the difference in the Y coordinates of two conjugate rays as perceived on the platen of the tracing table. The operator must continue his adjustment of the models until this parallax disappears and all rays then intersect cleanly. Ordinarily this process is applied to six pairs of rays, four being near the corners of the stereoscopic model and the other two being the principal points of the respective projectors.

When this has been accomplished, the operator has completed what is known as the relative orientation of the model.

The absolute orientation is the adjustment of the model so that it will have the desired scale and will be so inclined that contour planes as represented on the model will be parallel to the Multiplex table top. It is a relatively simple matter to adjust the model for scale by means of the horizontal control that has been provided in advance and plotted on the map sheet. It may be necessary for the operator to shift the drawing paper both in position and in orientation to accomplish this, but finally he will come out with a model of such size that, when tested in this manner, all given horizontal control points will superimpose exactly their positions as plotted on the map sheet. However, it still is necessary to incline the model more or less until each point whose elevation is provided by the field party will read that elevation on the vertical column of the tracing table. This is accomplished by four adjusting screws that support the horizontal bar. By their manipulation, it is possible to incline the model as a whole until it is in the desired position. The Multiplex model is then ready for the map drawing operation.

Drawing the Map

It is customary to draw the cultural details of a model first. This detail consists of highways, railroads, buildings, and all other works of man. This detail appears on the irregular surface of the optical model and, to secure an orthographic projection of it to the map surface, it is necessary for the operator to follow out the detail with the floating mark of the tracing table, manipulating it in such manner that the mark seems always to be in contact with the ground surface. The pencil delineates on the map sheet the exact position of the details if the model has been properly set up and the operator uses the necessary care. It is customary to ink in this detail in black at this time as, by doing so, the drawing is kept from smudging and better copy is secured for the later reproduction operations.

A woodland sheet which shows the area covered by woods is next drawn. This is not done on the original drawing, but on a vellum overlay, as it is desirable to keep this information off the map sheet where its presence greatly complicates the interpretation of the original drawing and materially delays the map engraver in delineating other important details. The lines are then inked in green to preserve them. This sheet becomes the copy from which the green woodland printing plate is made.

The contour lines are drawn in a different manner than has been described for cultural information. It will be appreciated that, if the floating mark of the platen is set to the height of a given contour plane,

it will always indicate the relation of that plane to the ground surface throughout the extent of the stereoscopic model. In other words, the elevation of the luminous mark does not change unless the platen is deliberately changed in height above the surface of the Multiplex table. This greatly simplifies the drawing of contour lines because the operator need set the platen only once for each contour plane throughout the model. The actual drawing operation is accomplished by causing the floating mark to move into apparent contact with the surface of the model, then lowering the drawing pencil to the drawing paper, and finally guiding the tracing table in such a manner that the floating mark is continually kept in contact with the apparent surface of the model.

Completion Survey

Stereoscopic methods of mapping, such as the Multiplex, call for a field examination of the office drawing since the operator is unable to delineate all of the details that must be represented on the map. Such detail as boundary lines, place names, houses hidden by trees, classification of roads, and positions of bench marks, cannot be determined by the operator and it is customary to send a photographic copy of the original drawing to the field in order that a skilled topographer can add this missing detail and sketch in any contours that the Multiplex operator may have decided could not be properly traced out on the model. Occasionally such places will be found due to the existence of heavy shadows in the photographs. The completion step is a very important one, but should not require a great deal of time if handled by a skilled topographer. Tests of maps drawn with the Multiplex instrument have shown that they are sufficiently accurate so that the topographer need not spend time checking for erroneous delineation of detail. After the changes in the original drawing have been made in accordance with the report submitted by the topographer, the map sheet is ready for reproduction either by photolithography or by engraving. In this respect, the map work does not differ at all from standard practice.

Horizontal and Vertical Control

The Multiplex method differs essentially from the planetable method in its requirements as to the amount of horizontal and vertical control that is needed. The matter of providing the special vertical control must be given very close attention and no attempt to reduce it can be made at this time without endangering map accuracy and slowing up progress. The peculiarity of this control is that it must be accomplished after the aerial photographs are made. This requirement necessitates careful planning in advance in order that the various important steps of the project can be carried on in proper order.

The special control to which reference has been made is known as supplemental control and should not be confused with the customary horizontal and vertical control which, for clearness in Multiplex work, is referred to as the basic control of the region. The basic control can be similar in distribution to that now provided for planetable work. The supplemental control is distinguished by the fact that it consists usually of the elevation of objects which appear in the aerial photographs near the corners of the stereoscopic models. It is essential that the positions and elevations be located in these positions in order that they will properly control the absolute orientation of the models. It is not possible to determine these positions in advance of the aerial photography as they depend entirely on the position in which the aerial photographs are made and the amount of overlap, not only between the photographs in the same strip, but between strips as well.

The density of supplemental points being used at the present time requires that horizontal positions be made available on the east and west edges of 7½-minute quadrangles, or every 8 miles, as this distance is the maximum that can be spanned with Multiplex bars of customary length. No intermediate points will be needed because it has been found that the Multiplex process will enable the operator to "bridge" his models successfully for this distance without introducing any important position errors in the map. However, much more vertical control is needed if the contour lines are to be accurately delineated. It is customary at the present time to ask for one elevation in each of the four corners of every stereoscopic model. It is an important step in the operation problem to determine where these points should be located and the minimum number that are needed to give this distribution. Naturally the operator responsible for the control planning program should select these points in such positions that they can be used on the maximum number of models.

Horizontal and vertical control projects have been carried out in several states, usually on the basis of controlling 15-minute quadrangles. For several reasons, it is not possible to operate the Multiplex instrument on scale sufficiently small to map an area as large as this in a single sheet, and it becomes necessary to prepare maps in 7½-minute rather than 15-minute units. Naturally, these four parts can be combined in the reproduction step if this is desirable. The Multiplex method requires a greater expenditure for control than is necessary for the planetable method. However, the important thing to consider in map work is not the cost of individual operations, but rather the total cost of the map. This will be lower ordinarily than can be accomplished with the planetable method, so the use of an additional amount of control is well justified.

Another important consideration in planning control for Multiplex

mapping is the accuracy with which this work should be accomplished. It has definitely been proved that both the basic and horizontal control must be carried out with greater precision than has been the case in the past for planetable mapping at scales of 1:48,000. It is necessary to make the Multiplex drawing for maps of a country of low relief at a scale of about 1:10,000. At this scale, a distance of 5 feet on the ground is appreciable, so it is essential that the basic horizontal control parties shall work with such care that errors greater than this shall not occur any place in the system. To have errors greater than this will delay the progress on the Multiplex instrument and, by so doing, will increase the cost of the work. Vertical supplemental control must be done with such an accuracy that errors which occur cannot be detected by stereoscopic measurements. It is a peculiarity of the stereoscopic method that the models cannot readily be forced into shapes that will make them agree with erroneous horizontal and vertical control, thus serving as a check on errors in field control surveys.

Aerial Photography

Photographs made for stereoscopic mapping use must be obtained with special cameras if true-to-nature models are to be obtained. Efforts to use existing negatives several years of age or to substitute a camera not of the proper quality or suitable focal length will be certain to result in delay to the operator and a poor map. Nothing that the Multiplex operator can do will enable him to deliver a good product if he is handicapped in this way. If a true perspective record is to be obtained, it is essential that the lens be as free of distortion as the present state of optical lens design will permit. The camera in which the lens is placed must be constructed with great care; in fact, it must be looked upon as a mapping instrument rather than a piece of photographic equipment, and it must be calibrated with the same care as the finest theodolite if best results are to be obtained. As a consequence of this requirement, it is rarely possible to use existing photographs for Multiplex mapping where contour lines will be shown. Moreover, the best photographs are those made upon glass plates, as this material holds its shape perfectly and thus avoids the possibility of film distortion that is so common in all roll-film negatives.

It is important to use cameras having a wide field of view and a short focus, as by so doing the area encompassed by each photograph is greatly increased and a great reduction in the amount of supplemental control obtained. In addition, there is a saving in time for setting up the models and a great increase in the air-base length, which makes for greater accuracy in the delineation of contour lines.

The camera that is used in any project must be calibrated by the National Bureau of Standards to determine its fitness for this type of work.

Map Accuracy

The first maps that were constructed by the U. S. Geological Survey with Multiplex instruments in the Chattanooga, Tennessee, office were subjected to severe tests by the Tennessee Valley Authority. The requirement was that accuracy of the contour lines should be such that 90 percent of the tested points should not show errors greater than one-half the contour interval. The first work done with the Multiplex instrument was from 7- by 9-inch photographs made with an 8¼-inch camera flown at an elevation of about 8,500 feet. This map was tested by very careful transit profile lines which started and closed upon basic traverse stations. A corresponding profile was interpolated from the map and superimposed over the transit profile line to reveal the inaccuracies in the map. The result of several such tests revealed that the accuracy for position was much better than is customarily expected in planetable work. In fact, the tests have revealed that the errors in position are so small that it is rather difficult to detect them.

Similar tests have shown that, with the present type of equipment and thoroughly skilled personnel, it is possible to make the photographic flights at an elevation approximately 600 times the contour interval of the map to be drawn and secure an accuracy of contour delineation equal to that just mentioned. Consequently, as in other steps of the Multiplex process, it is necessary to determine in advance the map accuracy desired, thus fixing the height from which the photographic exposures will be made, and this in turn will fix the scale of the original Multiplex drawing.

Connecticut Adopts Map Accuracy Code

A Code of Recommended Practice for Standards of Accuracy of Maps has been adopted by the Connecticut State Board of Registration for Professional Engineers and Land Surveyors. The Code was prepared by a joint committee representing the Connecticut Section of the American Society of Civil Engineers and the Connecticut Society of Civil Engineers.

The general purpose of the Code is to present uniform methods and procedures by which maps may be classified and identified according to specified degrees of accuracy. The Code covers maps and plans which may become public land records, be used as court evidence, or represent data acquired, assembled, or calculated for a client by a land surveyor.

Copies of the Code may be obtained from H. Jackson Tippet, 120 Westwood Road, New Haven, Conn., at a cost of 25 cents per copy.

Surveying and Mapping in the Junior College

By CHARLES R. HERR*

AFTER a careful study of the articles by Professors Zelner and Rayner in the October 1944 issue of SURVEYING AND MAPPING, I wish to add a few words from the Pacific Coast area—especially southern California.

Prof. Zelner states, "The opinion is strongly voiced by many that in the usual 4-year course in Civil Engineering there is no room for specialization." We must also admit that with all the branches of Civil Engineering along with the many special branches in Surveying and Mapping there is no room for specialization in either engineering subjects or Surveying. With all of these important fields and branches can we not use a more comprehensive course in Surveying and Mapping to tie the general field of engineering together? But here comes the snag. The curricula are set up by committees to cover the field of engineering. All of the subjects are important, especially to the faculty representative of a particular field, resulting in a debate as to what shall be emphasized and what should be minimized.

This is where Surveying and Mapping usually take a beating, especially where the C.E. degree is the goal. You must go to class to get Structures, Hydraulics, and many other subjects, but in Surveying all you need is some lectures plus a little field practice and a summer's job on a survey party. At the California Institute of Technology 42 percent of the purely C.E. courses are in Surveying—mostly lectures, with three courses having allotted time for field work. A short lecture on Land Subdivision is included but no field work, and nothing on "Survey of the Public Lands of the United States." This all adds up to a good engineering background but leaves the graduate lacking in Surveying to the extent that in most cases he is a liability instead of an asset to his employer.

This all adds weight to the contention that there is room in some schools for a degree in Surveying and Mapping—a course where the various fields of engineering are tied into Surveying as they might have to be met in the field, on the job, or from a blueprint. Such a course should not be too hard to set up, once you get a school to sponsor it.

A 2-year program, along the lines suggested, was given at the Pasadena Junior College by the writer. To establish the best curriculum to meet the demands of the engineering field, the writer went to this field and obtained its answers to three sets of questions: (*a*) Subjects or courses

* Teacher of Surveying, California Institute of Technology.

to be considered, (*b*) courses to be taken in Mathematics, and (*c*) list of problems to be covered in Surveying and Mapping. Before asking the questions, each engineer was asked to give his answer as to what he would want the graduate to know if he expected to hire him. The engineers interviewed covered a wide field of experience, such as: public utilities, including electric, gas, water, and telephone; oil companies; state, county, and city surveyors; state highway; draftsmen of various offices and those in private work. All of these engineers had been in the field at least 15 years, which gave added weight to their responses.

To get the academic point of view, the report of "The First Surveying Teachers' Conference" was studied as well as articles published by the "Journal of Engineering Education" and other similar journals.

So with the study of the engineering curricula, the answers of the experienced engineer, and 9 years' field experience of my own, a 2-year Junior College course called "Civil Technology" was instituted. This course was given 20 hours a week for 2 school-years and included the following general topics: (*a*) Surveying, (*b*) Mapping, and (*c*) Problems in General Construction, including testing the strength of materials. Besides these somewhat specialized courses, the student had his regular classes in such subjects as English, Technical Reports, Social Sciences, which were needed to meet the State requirements for graduation from a Junior College.

To help keep on the right track, a group of representative engineers would be called in now and then for an evening meeting to discuss new methods and ideas and to see if the instructor was giving the proper kind of field work and map problems.

Aerial Surveys in Highway Work

AERIAL SURVEYS are being used with an increasing amount of success in the planning and location of Kansas highways, declared Paul Martin, engineer of design, Kansas State Highway Department, at the last annual meeting of the American Association of State Highway Officials.

That aerial photographs are sufficiently accurate for preliminary highway location surveys was brought out in a paper on highway construction in Bear Mountain Park, New York, by Samuel Nelson, deputy chief engineer of the Palisades Interstate Park Commission. Road grading quantities can be computed to an acceptable degree of accuracy from cross-sections established by aerial photography at locations where the terrain does not change too abruptly. To establish this fact, said Mr. Nelson, quantities for a 1-mile section of grading were computed using cross-sections established from both aerial and ground surveys. Results disclosed that the average variation between the two methods did not exceed 4.2 percent.—*Engineering News-Record* (News Issue), December 21, 1944.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

DESLINDE DE CONCESSIONES EN EL ECUADOR. R. Thistlethwaite, *Boletin, Instituto Sudamericana del Petroleo*, April 1944. (Describes surveying difficulties in the petroleum zone of Ecuador, including tolerance in accuracy of survey work.)

THE SOLUTION OF A TRIANGLE ON A MACHINE. H. B. Thompkins, *The South African Survey Journal*, June 1944. (A modification of the old tangent method.)

THE SURVEY OF AN EXISTING RAILWAY CURVE. G. B. Lauf, *The South African Survey Journal*, June 1944. (Describes method which may be used to obtain a result in conformity with requirements of the Land Survey Act for the survey of a railway curve as a boundary.)

RAILWAY CADASTRAL SURVEYS. R. C. Blunt, *The South African Survey Journal*, June 1944. (Describes methods of traverse surveys and the reduction of measured lengths by machine.)

PRACTICAL SURVEYING OF TOWER LINES. R. B. C. Taylor, *Electrical Times* (London), August 10 and 17, 1944.

A METHOD OF GRADING IN INCLINED SHAFTS. J. E. Metcalfe, *Mine and Quarry Engineering* (London), October 1944. (Describes a method of establishing a grade-plane in an inclined mining shaft by the use of a special device fitted between the tripod-head and the theodolite by which the instrument can be raised or lowered above the head.)

AERIAL PHOTOGRAPHIC SURVEYS FOR BETTER HIGHWAYS. W. H. Simonson, *American Highways*, October 1944. (Application of aerial photography to layout of road and highway systems; apparatus used and limitations of method are discussed.)

FUNDAMENTALS OF PHOTOGRAMMETRIC ENGINEERING. (Part I—Aerial Photographs and Their Use in Planimetric Mapping. Part II—Aerial Photographs in Topographic and Military Mapping.) Reynold E. Ask, *Engineering News-Record*, November 30 and December 14, 1944.

EARLY HYDROGRAPHY IN INDIAN SEAS. J. M. Lacey, *Dock & Harbour Authority*, November and December 1944. (An account of the Middle East Martime Surveys during 18th and 19th Centuries.)

THE SOCIETY'S NEW MAP OF SOVIET RUSSIA. *National Geographic Magazine*, December 1944.

K. E. K. STEREOSCOPIC PLOTTER. J. E. King, *Photogrammetric Engineering*, December 1944. (Describes the development of the K. E. K. plotter to meet the Forest Service requirements for a stereoscopic instrument of simple and low-cost construction.)

A METHOD OF MATCHING TOPOGRAPHIC SHEETS WITH A STEREOSCOPE. E. R. Hendson, *Photogrammetric Engineering*, December 1944. (Also describes use of stereoscope for transferring penciled or inked data from contact prints to a mosaic.)

PHOTOLITHOGRAPHY AND THE WAR. Joseph K. Rulon, *The Du Pont Magazine*, November–December 1944. (An illustrated story of the reproduction of maps by photolithography at the Army Map Service and the use of Photolith Film in the process.)

A CALCULATING-MACHINE COMPUTATION FORM FOR THE THREE-POINT PROBLEM ON A GRID. Howard Eves, *Civil Engineering*, January 1945.

WOMEN IN NAVIGATION SCHOOLS. Mark Fyffe, *The Nautical Magazine*, January 1945.

EARLY REFLECTING INSTRUMENTS. W. E. May, *The Nautical Magazine*, January 1945.

DEFECTS OF SURVEYING TELESCOPES. Arthur Lovat Higgins, *Empire Survey Review*, January 1945. (Discusses defects in external- and internal-focusing telescopes, as applied to theodolites and levels, and the errors resulting therefrom.)

REWEBBING DIAPHRAGMS WITHOUT TEARS. A. V. Lawes, *Empire Survey Review*, January 1945. (A mechanical rewebbing stage from ordinary survey equipment available in the field.)

TOPOGRAPHIC MAPPING IN NORTH CAROLINA. Dallas H. Walson, *North Carolina Engineer*, January 1945. (Describes the status of federal topographic mapping in North Carolina, including War Department mapping.)

CONTROLLED AREA—FORT PIERCE, FLORIDA. Charles B. McAdam, *The Military Engineer*, February 1945. (Describes the method used to establish horizontal and vertical control in a test area to be used for aerial camera calibration and stereoscopic test mapping.)

COLLECTIVE BARGAINING FOR ENGINEERS. V. T. Boughton, *Engineering News-Record*, February 8, 1945. (Summarizes past events and appraises present situation with respect to collective bargaining for engineers.)

MAPPING SOME OF THE EFFECTS OF SCIENCE AND TECHNOLOGY ON HUMAN RELATIONS. S. W. Boggs, *The Department of State Bulletin*, February 11, 1945.

MAP MAKING AS A JUNIOR HIGH ELECTIVE. Margaret S. Chew, *The Journal of Geography*, March 1945. (Describes the course inaugurated at the Haven Intermediate School at Evanston, Illinois, and some of the values gained from its introduction.)

ECONOMICS OF PHOTOGRAMMETRY. Leon T. Eliel, *Proceedings*, American Society of Civil Engineers, March 1945. (Describes briefly the various stereoscopic processes in use today for making contour maps from aerial photographs and discusses the merits of the various systems from an operating cost basis; compares also photogrammetric method with planetable method.)

BOOKS

THE ATLAS OF CONGRESSIONAL ROLL CALLS, Volume 1: The Continental Congresses and the Congresses of the Confederation, 1777–1789. Clifford L. Lord, Editor. *New York State Historical Association*, Cooperstown, N. Y. 1943. 32 pages of text. 589 maps. $10.50. (The first part, and at present the only published one, of a large work to consist of 42 volumes, in which maps will be presented recording the votes in all roll calls in Congress from 1777 to 1937.)

HIGHER SURVEYING. Arthur L. Higgins. *The Macmillan Company*, New York. 1944. 463 pages. $5.00. (Deals with engineering surveys, photogrammetry, field astronomy, geodetic surveys, and errors.)

ALIGNMENT CHARTS: Construction and Use. Maurice Kraitchik. *D. Van Nostrand Company, Inc.*, New York. 1944. 94 pages. $2.50. (An exposition of the methods and techniques involved in the construction of nomographic charts.)

OBSERVATIONS AND RESULTS IN PHYSICAL OCEANOGRAPHY (Oceanography—1A). H. U. Sverdrup and others. *Carnegie Institution of Washington*. 1944. 156 pages. $2.50. (Describes results of Cruise VII of the *Carnegie* during 1928–1929 under command of Captain J. P. Ault.)

PERSPECTIVE CHARTS. Philip J. Lawson. *Reinhold Publishing Corporation*, New York. $2.00. (Consists of a set of eight charts, each 21″ by 24″, with detailed instructions for use in making architectural or other perspective drawings.)

TECHNOLOGISTS' STAKE IN THE WAGNER ACT. M. E. McIver and others. *American Association of Engineers*. 260 pages. $2.00. (Describes the National Labor Relations Act in operation as it affects engineers, chemists, and architects.)

THE WAR IN MAPS. Francis Brown. *Oxford University Press*, New York. 1944. $2.00. (An atlas of New York Times maps.)

THE WESTMINSTER HISTORICAL ATLAS TO THE BIBLE. George Ernest Wright and Floyd Vivian Filson, Editors. *The Westminster Press*, Philadelphia. 1945. 114 pages. 77 illustrations. 18 colored plates. $3.50. (Westminster aids to the study of the scriptures.)

BOOKS RECEIVED

MANUAL OF PHOTOGRAMMETRY. American Society of Photogrammetry. *Pitman Publishing Corporation*, New York. 1944. 841 pages. $8.50. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

ELEMENTS OF MAP PROJECTION. Charles H. Deetz and Oscar S. Adams, U. S. Coast and Geodetic Survey. *Government Printing Office*, Washington, D. C. Fifth

edition. Revised 1944. 226 pages. 89 illustrations. 15 plates. $1.00. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

DISTINCTIVE RECENT MAPS

In 1942 the Ordnance Survey published a two-sheet base map of Great Britain, 1: 625,000, showing, instead of parallels and meridians, a system of squares 10 kilometers apart which form a part of the National Grid. The map is on the transverse Mercator projection, origin 49° N., 2° W. On this base there have been printed the Types of Farming and Land Utilization maps mentioned in the January 1945 issue of SURVEYING AND MAPPING, p. 63, and also three maps dated 1944, entitled "Topography," "Population Density, 1931," and "Administrative Areas." On the first of these hypsometric tints differentiate elevations of 100–300, 300–500, and over 500 meters, and the 50-meter contour is also shown. (British adoption of the metric system, both for this map and for the National Grid system, is noteworthy.) The population map is truly geographical in that the gradations in density are shown realistically as adjusted to topography, etc., rather than as arbitrarily limited by administrative boundaries.

The American Geographical Society has received a copy of "Carta Pluviométrica de Portugal, 1943," 1: 1,000,000, published by the Observatório do Infante D. Luiz. Eight gradations of mean annual rainfall in tints of green and purple are shown, from 200–400 mm. to over 2,500 mm. The Tagus marks the boundary between the relatively dry south (mostly less than 800 mm.) and the more humid north.

The large extent of territory in northeastern Venezuela held in oil concessions by the 11 principal companies operating there as of July 1, 1944, is strikingly brought out on a map, 1: 750,000, recently published by the International Map Company, New York. The holdings of the companies are shown by different colors.

The Planta Metallurgica Nacional de Medellín, an agency of the Ministerio de Minas y Petroleos of the Colombian Government, published in 1943 a "Mapa Geográfico y Minera del Departamento de Antioquia," 1: 250,000, in one huge sheet (approximately 5½ by 5 feet), and in 1944 a smaller map on the same scale and with similar title for the Department of Caldas. Both maps are in color and show drainage, administrative boundaries, roads, railroads, gold, coal and salt mines, marble and limestone quarries, but no contour lines. On both maps longitudes are given "al oeste de Bogotá."

Although many of the more distinctive of the maps currently being produced by government agencies are restricted and will remain so until the end of the war, a goodly number classed as "free" have been made available. Some of the most interesting of these, both in subject matter and in cartographic technique, have been issued by the Office of Strategic Services. Reference may be made, for example, to a clean-cut map of Germany (31 miles to the inch) showing the complex pattern of the administrative divisions; the boundaries and names of the lesser divisions (*Kreise*, etc.)

appear in black, and the larger divisions are differentiated by colors. A map of Japan (52 miles to the inch), shows the location and areas where there are hot and cold springs. For remote Kamchatka there are three maps: a general map (35 miles to the inch), on which relief is represented by hill shading in green (this brings out the volcanoes very effectively); and two smaller maps covering the distribution of population and of ethnic groups, administrative divisions, towns, and villages. An admirable feature of many of the maps produced by the OSS, including the ones of Kamchatka and Japan mentioned, is an ingenious key to the relative reliability of the data.

The American Geographical Society has received a map of France (scale 1: 400,000), dated January 1, 1944, showing in great detail the location of steam and hydroelectric power plants and four categories of electric transmission lines differentiated as to the load capacity. The map was published by the Syndicat des Entrepreneurs de Réseaux et Centrales Electriques.

JOHN K. WRIGHT

* * *

Mississippi Pioneers Training Course

ON MARCH 19, the Mississippi State Highway Planning Division inaugurated a 2-week training course in Aerial Mapping and Photo Interpretation and its utilization as an efficient and practical method for obtaining engineering data for highway planning.

To accomplish a good dissemination of this information, the states adjoining Mississippi were requested to send representatives. Six states: Alabama, Louisiana, Georgia, Arkansas, Missouri, and Mississippi, were represented in the class totaling 26 members. The individuals were key personnel of their respective departments.

The Abrams Industries of Lansing, Michigan co-operated with the Mississippi Highway Department in conducting the instruction and in furnishing equipment. Three members of their engineering staff; J. E. Meyer, K. A. Smith, and A. F. Warren conducted lectures and demonstrations on photo interpretation, planning the aerial survey, mosaics, map compilation, profile leveling with the contour finder, stereoscopic ground form lines, and theory of stereoscopy.

The course material was so outlined as to present to those attending, the best and most practical methods of obtaining engineering data for highway reconnaissance, traffic control, new location, profile leveling, and right of way problems from aerial photographs.

Similar schools are being planned by other state highway departments throughout the United States and the Abrams Corporation is co-operating with these agencies in arranging their lecture programs and assisting with the actual instruction.

Book Reviews

FOREIGN MAPS. Everett C. Olson and Agnes Whitmarsh. *Harper & Brothers.* New York. 1944. xvii and 237 pages. $4.00.

Reviewed by W. L. G. Joerg, Chief, Division of Maps and Charts, National Archives, Washington, D. C.

THIS BOOK provides a very useful survey of the large-scale topographic map series of the countries of the world and deals with the problems connected with their use. Its publication is stated (p. xi) to have been stimulated by present war needs.

After a brief chapter on the topographic maps of the United States, to serve as a transition from the presumably known to the presumably unknown, the topics are taken up in the order of practical use. Thus there are chapters on general considerations regarding the reading of foreign maps, on the information available on map margins, and on index maps as control tools of the arrangement and extent of coverage of given series.

There then follows a section, in two chapters, on language. The heart of this section is a set of alphabetically arranged glossaries in some 35 languages—with English equivalents—of terms occurring on foreign topographic maps. The glossaries do not repeat the same set of terms but reflect the words most frequently used on given map series, such as those relating to mountain environment in the Norwegian glossary and to lowland land occupancy and topography in the Danish glossary. The lists average some 100–300 words.

With glossaries of such unquestioned value, constituting perhaps the first available in American cartographic literature, it seems unfortunate, despite the authors' disclaimer of being expert linguists, that the foreign word lists were not subjected to closer scrutiny or proofreading before publication. In the glossary of one of the major European languages, for example, no less than 8 percent of all the words display misspelling, mistranslation, wrong accents or diacritical marks, or other forms of incorrect rendering. That this lack of linguistic precision is rather symptomatic is confirmed in other parts of the book, from which two instances may be cited. Hungarian is ascribed on page 95 to the Slavonic group of languages, although it is correctly classified on page 137. On page 220 poor Switzerland, a country which is trilingually tolerant, has to bear up under "*Carta* Nationale de *le* Suisse" and "Generalkarte der *Sweiz*."

The next three chapters deal respectively with signs and symbols, scales and measurements, and grid systems. Seven valuable diagrams are given, each reproducing the symbols used for given features on the maps of 12 selected countries. An especially valuable exposition of plane rectangular grid systems and a brief characterization (with diagrams) of seven foreign grid systems enhance the value of this section.

The final chapter briefly describes the characteristics of representative topographic series of some 40 foreign mapping agencies. It may be considered to be supplemented by the list of catalogues and reports of such agencies given in the list of references and by the colored and monogravure plates showing samples of

16 foreign topographic maps. The series selected for description are not always representative, as in the case of Egypt, where the typical 1:50,000 series is not even mentioned. The reader would do well to supplement his use of this section by checking with Chapter 18 in Raisz's *General Cartography,* a work which is cited in the list of references, and particularly by consulting the important series, not there mentioned, of reports on the status and progress of the national mapping agencies of the world, illustrated by index maps, which were issued by the International Geographical Union on the occasion of the Congresses held at Paris in 1931, Warsaw in 1934, and Amsterdam in 1938.

Notwithstanding its defects, most of which can easily be remedied in a second edition, this book constitutes a valuable guide to a field new to most of our present map users. Such revision will benefit if the authors keep in mind as a model their classical American predecessor, Captain George M. Wheeler's report on the "principal Government land and marine surveys of the world" (Corps of Engineers, War Department, 1885, 48th Congress, 2nd Session, House of Repr. Exec. Doc. No. 270), prepared as a result of United States Government participation in the Third International Geographical Congress, held at Venice in 1881.

AERIAL PHOTOGRAPHS: Their Use and Interpretation. A. J. Eardley. *Harper & Brothers,* New York. 1942. 203 pages. $2.75.

Reviewed by Philip B. King, Geologist, U. S. Geological Survey, Department of the Interior, Washington, D. C.

THIS BOOK is one of several now available on the use of aerial photographs for mapping. As it is relatively brief, a large number of topics in this rapidly growing field must be briefly summarized. For this reason, it will, however, serve as a useful introduction for the beginning student, and aid him in understanding longer works on various phases of the subject.

The first 70 pages are devoted to introductory matter and to general theory and technique. One chapter deals with stereoscopic vision, another with mosaics, and the remainder of the book with specialized subjects. As the author is a geologist and is writing primarily for geology students, a large part of the book deals with the application of aerial photographs to geologic investigations. This discussion is illustrated by numerous striking photographs. By contrast, interpretation of culture and the use of photographs in military operations are dealt with in two brief chapters, each with a single illustration.

The geological part contains considerable discussion of geologic maps and geologic theory (chapter V), on the assumption that the reader is not thoroughly conversant with these subjects. The succeeding chapters describe methods of working out geologic features on photographs. Useful observations are given on transforming observations on the photographs into geologic maps, structure contour maps, and cross-sections. The reader is made aware that, although many geologic features may be discovered from study of photographs, final decision

must await examination of these features on the ground. However, because of the space limitations of the book, not much attention is devoted to the actual use of such photographs in geologic field work.

The book contains many striking illustrations, particularly of geologic features, but there is a regrettable absence of stereoscopic pairs which would permit the reader to study in relief the features shown.

"Topographic Mapping Needs"

THE PENNSYLVANIA State Planning Board at Harrisburg recently published a ten-page pamphlet on the "Topographic Mapping Needs" within the State. This study provides Recommendations for Priorities and Scales which have been reduced to a mathematical basis. One of the outstanding features of the study is that the State departments and the interested public utility companies have been given an opportunity to express their respective needs on a priority basis ranging from 1 to 4 or more years.

This information is believed to be of considerable value to the Federal Government as well as to map users in Pennsylvania for it provides a means whereby the topographic mapping needs of the State and of the federal mapping agencies can be reconciled. Included in this study is a reprint of the "Standards for Map Accuracy" adopted by the federal map-making and map-using departments and establishments.

New Map of the Philippines

A NEW ADDITION to the National Geographic Society's wartime series of map supplements is the 7-color map supplement of the Philippines (March 1945). This map shows the Philippines in detail (7,083 islands in all) with an inset showing their setting between western New Guinea and Vladivostok, and their geographic relation to Japan, the Marianas, western Carolines, the Netherlands Indies, and the China coast. 3,787 names appear on the map. Two other insets are shown, one of Manila Bay and the other of Lingayen Gulf.

In compiling this new map, the latest data of the U. S. Coast and Geodetic Survey and the Army Map Service were used.

The new map is constructed on the polyconic projection, at a scale of 1:3,000,000, or 47.35 statute miles to the inch.

Property Surveys Division

EDITOR'S NOTE.—The material for this issue of the Property Surveys Division has been assembled by C. E. Hanson, Associate Editor of the Division.

QUARTERLY REPORT

On December 2, 1944, vice chairman E. H. Owens proposed that the Technical Standards Committee prepare a general standard of practice for the subdivision of land. A plan of procedure was immediately outlined by Chairman S. A. Bauer, requesting the officers and committeemen of the Division to submit to Wm. C. Wattles, Chairman of the Committee, methods of practice in their locality, with opinions and recommendations for a proper subdivision plat. Beginning wth the raw land, consideration was to be given to the various legal and engineering phases, necessary legislative acts, field location, and mapping details to the final recording of the subdivision.

C. E. HANSON

TECHNICAL STANDARDS COMMITTEE

Numerous suggestions and recommendations have been received and partly digested. The general trend is toward establishment of standards of mechanical value, such as monuments, methods of chaining and transit work, and map delineation. It appears that the most important branch of standardization, that of exact and legal title location method, has been almost wholly overlooked. Before any system of standards can be satisfactorily set up, or adopted, certain conditions must be considered, substantially as follows:

1. Flexibility to the extent that the standard can be modified to suit local needs and practice without reduction of high level procedure.
2. Wholehearted acceptance of the standard by those who have occasion to use it, and a genuine effort to maintain and enforce its use.
3. Provide a proper legislative act to require and direct standard practices, and provide penalties for failure to conform. This legislation should be statewide rather than restricted to local governmental bodies, and should include the naming of boards or other groups of land surveyors as directing and enforcing bodies.
4. Standardize all branches of land surveying, setting forth the objective to be attained, with a basic suggestion for operation, but not so rigid that the standard will work at a disadvantage in cases where local variance or particular needs of any problem require different treatment. This variance will apply also to the title analysis of a problem, and the legal angles applicable thereto.

5. Recognize the rule of accuracy and conformity in proportion to the needs of the particular case. For example, one does not attempt stadia closure to hundredths when readings are not possible closer than feet.

No set of standards has value unless it is fully recognized as a working model of procedure, enforced in operation, and accepted in final result, to the exclusion of other practices.

After the standard is established, the only way it can be made to live and out-compete other practices, is through *education*. Educate the surveyor, the client, the layman, the lawyer, the court. Reward the conscientious endeavor to conform and penalize the careless and indifferent.

WM. C. WATTLES, *Chairman*.

ARE PROPERTY SURVEYORS NECESSARY?

Los Angeles County has 1,221,000 assessed parcels of real estate. How many in your county? Thousands of additional parcels of real estate are created yearly. Total the number of parcels in the entire nation; yes a staggering figure. Descriptions and titles accompany each parcel. The property surveyors are delegated with the trusteeship of the location of the boundaries of all these parcels.

Why not make our importance known in the community?

—C. E. H.

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Plane-Coordinate Systems Authorized

DURING the survey sessions at the 92nd annual meeting of the American Society of Civil Engineers, attention was drawn to the fact that nine states have formally adopted the plane-coordinate system devised for the various states by the U. S. Coast and Geodetic Survey for transforming geodetic-position data for use in plane-surveying operations. Louisiana was the last state to adopt the method, the states of Kentucky, New Jersey, Mississippi, Texas, Massachusetts, North Carolina, Pennsylvania, and New York having already done so.

Legislation to authorize use of this system has been prepared for the remaining states.

In discussing methods for obtaining passage of such laws, the general agreement was that state engineering societies, municipal engineering groups, and local sections of national engineering societies can do much more than can the headquarters staff of national societies.—*Engineering News-Record* (News Issue), February 1, 1945.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way. —EDITOR.

MORE "SURVEYING AND MAPPING" REACTIONS

May I compliment you most highly on the job you are doing with SURVEYING AND MAPPING. Not only does it lead one to hope for an American publication similar to several European periodicals on surveying, but it has already achieved a certain stature of its own. The January issue, just received, is particularly noteworthy.—S. A. BAUER, Chairman Property Surveys Division.

Knowing that it is the desire to attract members from every class of those who do surveying and mapping, it is felt that an effort should be made to publish regularly news and articles of interest to all of these groups. I refer to men doing railroad, highway, public utility, construction, county, city, town, land, mining, real estate sub-division, hydrographic, etc., surveying, and especially to the individual surveyor and to the large and small firms doing a general surveying business. It is a question whether the engineer-surveyor in private practice is not more interested in knowing and discussing what men working along his own line are doing and planning, rather than reading so much about the activities and practices of the engineer who is in government employ. It is recognized that material is more readily available from government and college sources, but if the Journal is to attain a wide distribution and gain steadily in influence, it would seem that more material aimed at the practicing surveyor in the field should be featured.

A section regularly reporting the activities of state and area societies of surveyors would act as a clearing-house and serve to tie together these, at-present, relatively unrelated bodies.

Based on our experience and perhaps contrary to the belief of many members of the CONGRESS, compass surveying still seems to be a fairly large field for many surveyors, both old and young. Apparently, many of these have acquired their knowledge and skill through some form of apprenticeship. It would seem that the CONGRESS, through publishing articles or by holding regional conferences in appropriate locations, might further the education of these men and by so doing perform a worthwhile service not only to the men themselves but to the profession as a whole. The letter entitled, "Surveying Needs a Lift," in the October 1944 issue of SURVEYING AND MAPPING, seems to show quite definitely the desirability for such an educational program.—H. M. DIBERT, Chairman Division on Surveying and Photogrammetric Instruments.

I like SURVEYING AND MAPPING and it is a step in the right direction. It seems to me, however, that actual discussions of problems in the field should be given some space. For instance, a problem could be set up that some surveyor has run into during his work, such as in surveying a lot in a subdivision. Where the original measurements and the new were quite different, as they frequently are, members of the Congress may be willing to express opinions on how they would do the work, on prorating, on occupation, etc. Perhaps some court decisions would be interesting. This should create interest and I believe help to gain new land surveyor members.

I realize that some members may feel this should be a matter for the classroom or up to the individual, but there are times when one has a hard time to decide what course to take.—J. HAROLD HOLMQUIST, Registered Land Surveyor.

. . . I know there is no need of me endeavoring to stress to you the desirability, in fact necessity, of procuring and publishing more original articles, if we expect the Journal to take its rightful place in furthering and advancing the surveying and mapping profession. I feel, and I know you do likewise, that the Congress is "coasting along" when it has to resort to a great extent on "reprints." Among the commendatory remarks I have heard regarding the Journal, once in a while there is injected the somewhat critical comment that more original articles should appear. . . .

A constant effort must be made to drive home the fact that the State Coordinate Systems are available. The Journal is the ideal medium to call this to the attention of all local surveyors and engineers.

In the field of mapping, and to a great extent in the extension of cadastral surveys, the utilization of aerial photography and its related science of photogrammetry is, in my opinion, the greatest contribution to the surveyor and topographer made in the past century, and every issue of the Journal should have an elementary or non-technical article on the utilization of aerial photographs in all land-use problems.—MARSHALL S. WRIGHT, Vice President Region 2.

COLLEGE SEMINARS IN SURVEYING

S. A. BAUER.—In the article entitled "Land Surveying," in the January 1945 issue of SURVEYING AND MAPPING, the sentence that interests me most is the concluding one in which Mr. Browning suggests that the State College work out extension courses for the benefit of those engaged in land surveying.

That suggestion is in line with thoughts I have had for several years, and I hope that the Property Surveys Division will be successful in persuading engineering colleges to conduct periodic seminars in surveying, for the double purpose of furnishing refresher courses to the profession, and for keeping the profession posted on the developments in the practice of the profession and its instrumentation.

The increased use of geodetic controls, the manner in which plane surveying can best be co-ordinated with geodetic control, the value, technique, and use of State plane coordinates, the meshing of topographic surveying with aerial photographs and photogrammetry—all these and more—could be included in such courses.

The practicing surveyor is probably the most rugged of all the rugged individualists. Unfortunately, too often he takes pride in the fact that he is doing his work identically as he learned it some forty years previously. Unfortunately also, he is too often proud of the fact that he carries his entire knowledge in his head, and is entirely independent of text books. That is the prime reason that so many surveyors insist that topography can be taken only by cross section; while others maintain that topography should be taken only by planetable; and still others that topography can be properly indicated only by some other method that they happen to have been brought up on. Each will argue bitterly for his stand, allowing no room for the other man's method, whereas the true fact probably is, that all the methods have certain advantages and disadvantages, and that the method should vary with the circumstances and the job.

Seminars on surveying by engineering colleges would break down such narrow views, and would do much toward advancing the entire profession of surveying.

FROM A NEW MEMBER

CHAS. H. MILLER.*—There is no question but what your organization fills a long needed want in the profession of surveying and mapping.

While over a period of 20 years, my own work has been rather general, my special line has been topographic mapping, property line determination, and real estate developments.

My feeling is that in the past few years there has been a definite turn to more accurate work. Possibly in this State this has been due to the activities of the Connecticut Geodetic Survey, which has given the surveyor accurate horizontal and vertical control.

Another matter, at least of interest to me, and which I believe has been neglected—with the exception of the fine book "Boundaries and Adjacent Properties" by Skelton—is the legal aspect of boundary surveys. I believe that this important phase of surveying should receive more emphasis, so that a surveyor's judgment or opinion would have the benefit of legal decisions or similar cases.

* Registered Engineer and Surveyor, East Haven, Conn.

AN INDEX OF "SURVEYING AND MAPPING"

Some very splendid articles have been published in SURVEYING AND MAPPING in the last 2 years—valuable for reference purposes—so I would like to suggest the preparation of a comprehensive index at the end of 1945, October number. That would be a logical place for binding and make a volume about 2½ inches thick. In making this suggestion, I am duly appreciative of the many duties of our officers in wartime, but something else might be sacrificed to prepare it, and we all hope our wartime duties will lessen before 1945 is out.—PROF. PAUL P. RICE.

THE SAD EFFECT OF TOO MUCH AERIAL PHOTO COMPILATION

CONGRESS NEWS

Announcing A Prize Competition

The recently organized Property Surveys Division is developing rapidly and shows every indication of becoming a beneficial influence on the land surveying profession. To stimulate interest in the work of the Division and to obtain information as to the value of plane coordinates to the practicing surveyor, W. N. Brown, Inc., Washington, D. C., is offering two prizes, one of $25 and one of $10, for the best articles on:

"THE USE OF PLANE COORDINATES IN PROPERTY SURVEYS"

The Congress hopes that the competition will further the preparation of original articles based on actual experiences.

Rules of the Competition

The Committee on Publications has drawn up the following rules to govern the Competition:

1. Articles must not exceed 2,000 words.
2. Line drawings suitable for reproduction on one page 4½ by 6½ inches will be counted as 500 words of text.
3. The winning articles will be published in SURVEYING AND MAPPING; the Congress retains the right to publish excerpts from the others.
4. The Competition is open to anyone with practical experience in surveying, except officers of the Congress.
5. Articles must reach the Secretary, P. O. Box 470, Benjamin Franklin Station, Washington 4, D. C., not later than September 1, 1945.
6. The papers will be judged on the basis of their contribution toward a clearer understanding by the surveyor of the advantages and disadvantages of plane coordinates. The committee of judges consists of Messrs. Carroll F. Merriam, W. N. Brown, and S. A. Bauer.

The Congress will welcome prize sponsorships on other surveying and mapping subjects, such as "Monumentation and descriptions," "Map Information and distribution," etc.

G. D. WHITMORE, *President.*

NOMINATION FOR PRESIDENT

The Nominating Committee, appointed by President Whitmore, conferred in Washington on March 1–3 and nominated for the presidency of the American Congress on Surveying and Mapping

COMMANDER FRANK S. BORDEN

Chief, Division of Charts, U. S. Coast & Geodetic Survey

The Committee felt that a candidate close to Washington, well known, enthusiastic, and willing to contribute the necessary time and effort to the affairs of the Congress, would be found at the present time only in the government groups. Commander Borden has the necessary attributes to a high degree and has performed outstanding service as Chairman of the Committee on Publications of the Congress.

THE NOMINATING COMMITTEE:
Ralph M. Berry
W. N. Brown
Charles S. Fuechsel, *Chairman.*

SECRETARY'S NOTE.—Ballots were mailed to all members the first week in April and will be opened and counted at the Annual Meeting in June.

* * *

The Fifth Annual Meeting

Washington, D. C.—June 23, 1945

DUE TO wartime restrictions on transportation and public gatherings, the annual meeting of the American Congress on Surveying and Mapping will be limited this year to an evening program. In addition to a business session, the program will include a panel discussion on "Co-operation Among the Technical Organizations."

The policies and purposes of the various organizations concerned with surveying and mapping activities have been informally discussed for some time, but a formal exchange of opinions has never been effected. The Executive Committee believes that an interchange of ideas on how each organization can best serve the interests of all is desirable at this time.

THE EXECUTIVE COMMITTEE

* * *

PRESIDENT WHITMORE REPORTS ON BRAZIL TRIP

RECENTLY it was my privilege and pleasure to spend 4 weeks in the beautiful and interesting city of Rio de Janeiro, working with officials and staff members of Brazil's National Council on Geography in the planning of a national mapping program. During the first few days of my stay in Rio there was in session a national convention of Brazilian geographers, a professional group which in that country has much to do with national and local mapping matters. My visit, therefore, occurred at an unusually opportune time.

Needless to say, I thoroughly enjoyed the work in Rio de Janeiro, and the city itself, but enjoyed more the getting acquainted with many Brazilian members of the surveying and mapping profession. Every professional person with whom I became acquainted proved to be of the highest type—cultured, courteous, and enjoyable.

Among the surveying and mapping people in Brazil, there was evident a high regard for the American Congress on Surveying and Mapping. Editor Shalowitz especially should be glad to know that one or more copies of the publication SURVEYING AND MAPPING were observed in several of the offices which I visited. On one occasion it was consulted as a reference, for the purpose of proving a point under discussion. It is to be hoped that at some future time the Congress will be able to print special editions, in both Spanish and Portuguese, of each regular publication, so that the central and South American members of the Congress will derive more benefit from the publication. It is interesting to note, incidentally, that a surprisingly large number of Brazilian professional men are able to read English, and many speak it understandably. It would be a good idea if more United States citizens would include either Spanish or Portuguese, or both, in their study courses. There will certainly be a tremendous increase in travel between North and South America after the war, and it is to be expected that engineers, surveyors, and mappers will constitute a substantial portion of such travelers.

The Brazilian Government possesses, relatively speaking, a large amount of modern photogrammetric mapping equipment. In respect to certain types of high-grade instruments, it might be said to have more equipment, on a relative basis, than does the United States. Also there are many good technicians, well trained. If equipment and technicians could all be assembled into one organization, Brazil would indeed rank high among the federal mapping agencies of the world.

As to privately-owned surveying and mapping organizations, there are a few firms which have consistently produced rather large quantities of good work. In large-scale cadastral maps of city areas, Brazil seems to be well advanced. Specimen map sheets of such city surveys were

observed from several cities, and one could not avoid thinking that many United States cities would be much better off if they had similar survey and map information—for assessment and taxing purposes, for engineering planning, and for city planning. It was also my impression that city planning is a well-developed profession. It is probably true that where the benefits of city planning are appreciated, the need for city surveys is also appreciated.

The geodesists and photogrammetrists have the same problems in certain parts of Brazil that we have in many parts of the United States. For example, in southern Brazil, hazy weather during their summer season makes geodetic surveying and flying for aerial photographs extremely uncertain operations.

It was observed also that the map makers get their quota of requests for "hurry-up jobs," just as we do. I was shown one such job—the site of a proposed large steel mill, which was required to be hastily planned, with all its approach roads, railroads, employee housing, etc. The Multiplex map makers were notified in the usual casual manner that they must produce a large-scale accurate topographic map of the entire site within a very few weeks. This is sharply remindful of many recent surveying and mapping jobs for so-called project planning here in the United States.

It was noted too that the administrators of certain mapping agencies in Brazil seem to have the same kind of difficulties as many United States mapping administrators often have in obtaining sufficient funds for mapping projects. Appropriating authorities everywhere, it seems, are not usually technical men, and so the building up of an appreciation of the usefulness of good maps is slow work everywhere. Like a lot of other things, it seemed to take a war to demonstrate to public officials, and the public generally, how really important good maps are. It is to be hoped that legislative authorities will realize that basic maps are just as necessary in peacetime.

A striking shortcoming of the Portuguese language was noted. There appears to be no word in Portuguese which, precisely translated, means the English equivalent of "surveying." It was facetiously suggested that the Portuguese speaking members of the American Congress on Surveying and Mapping appoint a committee for the purpose of coining such a word.

Naturally, I cannot avoid feeling encouraged regarding the probability of better relations between the surveyors and mappers of the two Americas. It is my feeling that we have just begun on what will be, on a progressively increasing scale, pleasant and profitable relations between the two parts of the Western Hemisphere. As modern transportation further improves, a trip from the United States to any part of South

America will be less time-consuming, and less expensive, than only a few years ago was required for a trip from the East Coast of the United States to the West Coast. From my contacts in Brazil, I feel sure that many South Americans of the surveying and mapping profession will soon be visiting North America, for both pleasure and profit, and there is every reason to expect similarly that increasingly large numbers of North Americans will travel to South America for the same purposes. There should be many such opportunities for the young technical men of the profession and for United States equipment manufacturers and other firms.

GEORGE D. WHITMORE

BACK ISSUES WANTED

Requests are being received for back issues of the BULLETIN from libraries and from new members who want to keep a complete file. The following numbers have been specifically requested:

1941—June, Oct., Nov., Dec.
1942—Jan., Feb., March, April–May

Members are urged to send to the Secretary any of the above issues they may have lying around and for which they have no further use.

Illinois License Law Unconstitutional

AN ENGINEER license law for the State of Illinois, which was passed in 1941, was declared to be unconstitutional by the State's Supreme Court on September 19, 1944. The Court found that the act delegated legislative authority to the committee set up to administer the law, and found the act so lacking in definiteness as to what constitutes the practice of professional engineering as to be unenforceable. The Court also declared the act's provisions respecting examinations to be inequitable.

A FAR CRY FROM LAND SURVEYING

The sculpture work of Mr. S. A. Bauer, Chairman of the Property Surveys Division of the CONGRESS is being presented by the Ten-Thirty Gallery in Cleveland, April 3–May 5, 1945.

In Memoriam

HERBERT M. DIBERT, secretary-treasurer of the W. & L. E. Gurley Company of Troy, New York, and a prominent officer of the American Congress on Surveying and Mapping, died suddenly of a heart attack at his home in Troy on April 7.

Born in Johnstown, Pa., January 22, 1885, Mr. Dibert received his early education there. Choosing a career in engineering, he entered Rensselaer Polytechnic Institute, from which he was graduated in 1908 with a degree in Civil Engineering. He remained at Rensselaer to teach railroad construction, his special scholastic study, then continued to teach the same subject at the University of Pennsylvania until 1912 when he joined the W. & L. E. Gurley Company. There he attained a position of high responsibility in a matter of 5 years.

Mr. Dibert's absence will be keenly felt by all elements of the surveying profession, but especially by the Congress on Surveying and Mapping, of which he was a founder member and Chairman of the Technical Division on Surveying and Photogrammetric Instruments, and by Committee 8 (Surveying and Mapping) of the Society for the Promotion of Engineering Education, of which he was secretary.

Mr. Dibert, perhaps more than any other leader of the surveying and mapping profession, made it his hobby to attend all types of surveyors' conferences, and to take an active part in the affairs of all organizations having to do with surveying and mapping matters. He was especially interested in the so-called "grass-roots surveyor," on whose behalf he spoke and acted often. His untimely passing is a distinct loss to the profession.

He is survived by his wife, Mrs. Helen M. Gurley Dibert, and his daughter, Betsy.

—G. D. WHITMORE

LIEUT. LEONARD R. COLVILLE, a charter member of the American Congress on Surveying and Mapping, was killed in a plane crash in India on June 11, 1944, according to word received from his mother. A draftsman with the Tennessee Valley Authority, Lieut. Colville entered the Armed Forces in October 1941, was transferred from the Engineers to the Air Corps in April 1942, and received his commission at Marianna, Florida, on March 25, 1943. Assigned as a pilot to the India-China wing of the Air Transport Command, he was engaged in dropping supplies behind the Burma lines when his plane crashed.

—R. T. EVANS

NEW MEMBERS

ABEL, WILLIAM H.
Registered Civil Engr., 1300 Schuyler Rd., Beverly Hills, Calif.

ASK, REYNOLD E.
Photogrammetric Engr., U. S. Coast & Geodetic Survey, Wash., D. C.

BATES, FRANK J.
Assistant Topographic Engr., U. S. Geological Surv., Rolla, Mo.

BOOTH PIERSON
Booth & Dickerson, Civil Engrs. & Surveyors, Warwick, New York

BRITTON, G. C.
Engineer, Imperial Oil Ltd., 56 Church St., Toronto, Ontario

CHENEY, FRANK L.
Superintendent, Engr. Div., Public Works Department, Needham, Mass.

DEMLER, LESTER E.
Sales Engr., Wallace & Tiernan Co., 877 Valley Road, Montclair. N. J.

EISENMAN, FRANCIS T., JR.
Eisenman Engineering, 1300 Schuyler Road, Beverly Hills, California

FAIRLEY, PAUL
U. S. Engineers, Box 97, Memphis, Tennessee

GALLIMORE, H. C.
The F. A. Pease Engr. Company, Terminal Tower, Cleveland, Ohio

GOSSETT, FRANKLIN R.
Lieutenant Commander, U. S. Coast & Geodetic Survey, Washington, D. C.

GRINNELL, WILLIAM P.
Instrumentman, Ohio Dept. of Hgwys., 516 Auditorium Bldg., Cleveland, O.

HAYES, JAMES P.
Supervisor of Surveys, City of Los Angeles, City Hall, Van Nuys, Calif.

HOLCOMB, W. T.
Asst. Highway Engr., State Highway Dept., Carson City, Nevada

HUGHES, FRED J.
Instrumentman, Cleveland Geod. Sur., 11216 Fairhill Rd., Cleveland, O.

HUMPHREY, CLARENCE B.
Director of Surveys, Massachusetts Land Court, Boston, Massachusetts

IRAZABAL, MARTIN
Mayor, Instituto Geografico Militar, Montevideo, Uruguay

JOHNSON, A. CLARENCE
Deputy County Surveyor, 700 Hall of Records, Los Angeles, California

KEITHLINE, JOHN H.
Engr., Conn. State Highway Dept., 14 Lewis St., East Hartford, Conn.

KENDALL, ARTHUR W.
Major, Ch., Map Production, Office Chief of Engineers, Wash., D. C.

LENNOX, ARTHUR H.
Engineer, Member Planning Board, 178 Morris Ave., Springfield, N. J.

LEWIS, MELVIN H.
Civil Engineer, U. S. Forest Service, Ogden, Utah

LOGAN, R. W.
Vice Pres., Grant Photo Products, 18915 Detroit Ave., Cleveland, O.

LUTTRELL, JOSE R., JR.
Ministerio de Obras Publicas, Pan., Box 1422, Ancon, Canal Zone

LYDDAN, ROBERT H.
Associate Topographic Engineer, U. S. Geological Surv., Wash., D. C.

MASON, CLARENCE R.
Assistant Topographic Engineer, U. S. Geological Surv., Wash., D. C.

MILLER, CHARLES H.
Private Practice and Town Engineer, 265 Main St., East Haven, Conn.

NEFF, CYRIL W.
C.E. & Surv., Cleveland Reg. Geod. Surv., 4006 Albertly Ave., Parma, O.

NELSON, W. T.
Survey Party Ch., City of L. A., 13456 Reedley St., Van Nuys, Calif.

O'BRIEN, DONALD P.
Asst. Civil Engr., TVA, 115 Alden Ave., Chattanooga, Tennessee

PEKAREK, JAMES C.
Engr., Cleveland Reg. Geod. Survey, 17426 Talford Ave., Cleveland, O.

REED, HAROLD A.
Surv., Cleveland Reg. Geod. Surv., Baldwin Reservoir, Cleveland, O.

ROSE, STEPHEN
Engineering Draftsman, U. S. Coast & Geodetic Survey, Wash., D. C.

RUNYAN, RUSSELL H.
Associate Topographic Engineer, U. S. Geological Surv., Wash., D. C.

SAUERS VON, RUSSELL J.
Del. Valley Engrs., Water Dept., 143 Ball St., Port Jervis, N. Y.

SHEPPARD, WILLIAM E.
Survey Sup., Bureau of Engrs., 5342 La Mirada Ave., Los Angeles, Calif.

SIEMS, FREDERICK B. T.
Captain, U. S. Coast & Geodetic Surv., 400 Insurance Bldg., Seattle, Wash.

SLOCUM, RALPH G.
Engineer, U. S. Engineers Office, Galveston, Texas

SMART, LELAND RAY
Chief, Proofreading & Checking Sec., U. S. Geological Surv., Wash., D. C.

TRACY, JOHN
1st Lieut., Mil. Intelligence Div., Corps of Engineers, Wash., D. C.

WEBB, JAMES B.
Topographic Engineer, U. S. Coast & Geodetic Survey, Washington, D. C.

WHITE, GEORGE C.
Div. Engr., Wallace & Tiernan Co., 171 Second St., San Francisco, Cal.

WILK, FORD A.
Engr. Aide, Dept. of Highways, 516 Auditorium Bldg., Cleveland, O.

WILKE, NORMAN M.
Engr. of Design, Dept. of Highways, 516 Auditorium Bldg., Cleveland, O.

WOOLLEY, GLEN B.
Cartographic Engr., U. S. Coast & Geodetic Survey, Washington, D. C.

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THE AMERICAN CONGRESS ON SURVEYING AND MAPPING is a non-profit organization whose objective shall be: "To advance the sciences of surveying and mapping in their several branches, in furtherance of the public welfare and in the interests of both those who use maps and surveys and those who make them, and to establish a central source of reference and union for its members; to contribute to public education in the use of maps and to encourage the prosecution of basic mapping programs which are paid in whole or in part with public funds."

Any person interested or engaged in surveying and mapping whose application has been approved by the Committee on Admissions may become a member of the CONGRESS.

AMERICAN CONGRESS ON SURVEYING AND MAPPING

Box 470, Benjamin Franklin Station, Washington 4, D. C.

I hereby apply for membership in the AMERICAN CONGRESS ON SURVEYING AND MAPPING and agree to be governed by the Constitution, Bylaws, and Rules of the Congress while holding membership.

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(With desired title of address)

Address .....

Occupation (with title) .....

Please give two references (not necessarily members of the Congress):

(1) ....
(Name) (Address)

(2) ....
(Name) (Address)

Annual dues of $4.00 of which $3.00 is set aside for the publication of SURVEYING AND MAPPING, are payable on notification of acceptance and entitles members to all privileges of the Congress and to all its publications.

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